FAA-E-2806b
November 14, 1989
Superseding
FAA-E-2806a
December 21, 1987

U.S. Department
of Transportation

**Federal Aviation
Administration**

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Specification

Terminal Doppler Weather Radar

FIGURES

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APPENDIXES

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1. SCOPE.

1.1 Identification. This System Specification establishes the performance, design, development, and test requirements for the Terminal Doppler Weather Radar (TDWR) System. The TDWR System (6.2.46) includes the radar equipment, facilities, and buildings required to house the equipment (6.2.16), environmental controls, back-up power equipment with associated switching equipment, and the archive recorder. This specification also provides performance requirements for special test equipment (Base Data Recorder and Base Data and Product Display) and a Program Support Facility (PSF). The acquisition will be a turnkey concept including manufacturing, site preparation, installation, and test.

1.2 Purpose. The primary mission of the TDWR is to enhance the safety of air travel through the timely detection and reporting of hazardous wind shear (6.2.23) in and near the terminal approach and departure zones of an airport. Specific sources of the hazardous wind shear which are to be detected are microbursts and gust fronts (6.2.22). The secondary mission to be met by the TDWR is to improve the management of air traffic in the terminal area through the forecast of gust front induced wind shifts (6.2.51) at the airport, detection of precipitation, and ultimately the detection of other hazardous weather phenomena including turbulence and tornadoes.

1.3 Introduction.

1.3.1 Background. The currently defined National Airspace System (NAS) weather sensing projects satisfy most Federal Aviation Administration (FAA) hazardous weather detection requirements. However, there remain some hazardous weather conditions that will go undetected in the critical flight areas of the terminal environment. The most significant of these are low-level wind shears due to microburst and gust fronts. The TDWR project provides the capability for the detection, processing, and communication of hazardous weather information to controllers and pilots.

1.3.1.1 National Airspace System Plan.

1.3.1.1.1 Interim NAS. The TDWR is one project of the National Airspace System Plan. The plan's goal is the modernization and improvement of the Government systems supporting aviation commerce in the United States. The time after the plan has been implemented is called the "end-state" of the NAS. The period before all equipment of the NAS has been fielded is called the "interim" period. The TDWR will be fielded in the interim period. In the interim period the TDWR product information will be displayed to Air Traffic specialists, i.e. controllers and controller's supervisors, on equipment supplied under this specification.

1.3.1.1.2 End-State NAS. In the end-state of the NAS Plan, the TDWR will send weather product information to Air Traffic Control (ATC) computers (the Tower Control Computer Complex (TCCC)). The TCCC will send weather product information to the Area Control Computer Complex (ACCC). Also in the end-state, a mechanism will be provided to transmit TDWR hazard detection information directly to pilots.

1.3.2 Operational Concept.

1.3.2.1 End-Users. The end-users of TDWR outputs are local, approach, and departure controllers, their supervisors, and pilots.

1.3.2.2 Automatic Operation. The TDWR will automatically generate a set of weather products from radar base data (6.2.6). Base data consists of estimates of reflectivity, mean Doppler velocity, spectrum width, and signal-to-noise ratio (SNR) data. The TDWR will be given site specific adaptation information when the system is installed. Examples of site adaptation information includes: protected airport runway location(s), location of airport sectors of interest, warning message format, etc. Other parameters will be updated by maintenance personnel at regular intervals.

1.3.2.3 Operator Input. The primary input required of ATC specialists will be notifying the system of the active runway(s) so that the TDWR can provide wind shear (6.2.50) hazard information in active runway coordinates. The ATC supervisor will be able to tailor the display characteristics of some products on the situation display.

1.3.2.4 Site Location/Scanning Strategies. The TDWR will in most cases be sited near to, but not on, an airport and will scan a volume above the airport surface. At intervals the TDWR will make a 360 degree horizontal scan or two. At some airports suitable land may not be available for off-airport siting. At these airports the TDWR will be sited on airport. Different scan strategies will be used for on-airport siting than are used for off-airport siting. In either case, 360 degree scan(s) will be used for weather surveillance to meet FAA requirements and to provide weather information the TDWR needs for adjusting system elements; an example of this weather information includes collection of data on out-of-trip weather (6.2.35) echoes obscuring the weather in the vicinity of the airport.

1.3.2.5 Interfaces. Hazardous weather and shear information will be provided to local controllers, approach and departure controllers, and their supervisors. When the TDWR is fielded the TDWR will work with current generation FAA ATC equipment which has no capability for TDWR data. Accordingly, the procurement includes two display types, a supervisor's display and a controller's display, which are intended as an interim means for displaying TDWR alarms and information. In the interim configuration controllers will verbally relay hazardous shear messages to pilots because existing systems cannot do this automatically. Ultimately the TDWR will provide hazardous shear information directly to pilots via other FAA equipment.

1.3.2.6 Coverage. Basic TDWR coverage is required from ground level to 70,000 feet above ground level (AGL) out to 48 nautical miles (nmi) from the system. The required minimum range is 0.25 nmi. Exceptions to these requirements are that 1) no coverage is required which would require an antenna elevation angle above 60 degrees, and 2) reflectivity measurements are required, when demanded by Pulse Repetition Frequency (PRF)/Range dealiasing algorithms, out to 248 nmi. The requirements are derived from operational coverage requirements for 1) hazardous wind shear detection from ground level to 1,500 feet for all areas within 6 nmi of the airport reference point (ARP) (nominally the center of the airport), and 2) detection of gust fronts within 40 nmi of the ARP. These operational requirements can not be directly converted to the TDWR coverage requirements because: 1) the TDWR will generally be located off-the-airport, and 2) weather features located outside the operational coverage region are used in the weather algorithms. Accordingly, the TDWR coverage requirements are greater than the corresponding operational requirements.

1.3.2.7 Modes. The TDWR will operate in one of two operational modes or a maintenance mode. The operational modes consist of a "Monitor" mode and a "Hazardous Weather" mode. In the Monitor mode the TDWR will use 360 degree azimuth scans at various elevation angles. This mode is used when algorithms determine that hazardous weather is unlikely. This mode reduces demand on the pedestal and will improve reliability. In the Hazardous Weather mode the TDWR will use a combination of sector scans over the protected airports and 360 degree horizontal scans. The Hazardous Weather mode will automatically be selected when Government supplied algorithms determine that hazardous weather is present or could be expected. The system will automatically revert to Monitor mode when the algorithms determine that hazardous weather is unlikely. The Maintenance mode, a non-operational mode, is selected when a maintenance action is required that may cause system performance outside of specified tolerances. The Maintenance mode may be selected on-site by a maintenance specialist and remotely through FAA maintenance computers. Use of this mode will be coordinated with Air Traffic personnel.

1.3.3 TDWR Functional Requirements. TDWR requirements are divided into the following major functional areas:

a. Radar Data Acquisition (RDA),
b. Radar Product Generation (RPG),
c. Remote Monitoring Subsystem (RMS)(6.2.42),
d. Display Function (DF).

1.3.3.1 RDA Function. The RDA function is responsible for acquisition and signal processing of base data, clutter suppression, control, monitoring, and base data error detection. The RDA function is accomplished by the antenna subsystem, the transmitter, receiver, and signal processing equipment.

1.3.3.2 RPG Function. The RPG function is responsible for control command generation and real time product generation. The RPG will provide the intelligence which allows the TDWR system to automatically fulfill its tasks.

1.3.3.3 RMS Function. The RMS function is provided for automatic fault detection and location. The RMS is also the entry port for maintenance commands and control and for entering site adaptable data. The RMS will provide maintenance related data and control functions to FAA maintenance specialists. The RMS is functionally independent of the major TDWR system functions.

1.3.3.4 Display Function. The display function will display the TDWR output to controllers and supervisors. The initial TDWR display function consists of controller's alphanumeric (ribbon) and supervisor's situation displays and will be superseded by other displays, not part of the TDWR project, in the end-state NAS. The display function and the RPG will communicate via Government furnished communications circuits. The ribbon display will be an alphanumeric display with audible and visual alarms (6.2.4) for use at the Air Traffic Control Tower (ATCT) and the Terminal Radar Approach Control Facility (TRACON). The ribbon display will present hazardous warnings which are to be read verbatim to affected pilots. The situation display will supply area wide TDWR weather information which will be used to assist the ATCT and TRACON supervisors in making strategic decisions as to airport configuration, traffic flow, etc.

1.3.4 **Archiving**. The TDWR will support the storage of weather products and related data. In the interim period before the end-state of the NAS, the TDWR will, upon command from the situation display, archive the latest preceding hour of products. In the end-state of the NAS the TDWR weather products displayed to controllers will be archived by ATC computers which are not part of the TDWR.

1.3.5 Base Data Output. The base data port of the TDWR will be used to record radar base data when a Base Data Recorder is attached. Base Data Recorders will be supplied by the TDWR contractor, but will not necessarily be present at each TDWR site. Base data recording is intended to support the initial installation of the TDWR. The recorded base data will be reviewed at the program support facility to verify the correctness of the meteorological site adaptation parameters.

1.3.6 Expansion. Refinements, improvements, and increased capability in the TDWR algorithms, and the later addition of tornado, turbulence, and microburst prediction products will inevitably result in increased processing requirements beyond that provided in the initial system. The system functional requirements specified are intended to accommodate these expansion requirements.

1.3.7 Products. The TDWR's main products are microburst detection, gust front detection, wind shift prediction, and precipitation detection. As technology and funding permit, turbulence and tornado detection products and microburst prediction will be added to the TDWR. The TDWR product characteristics may be found in Appendix A and Engineering Report No. ER/300-87-08-001.

1.3.8 Relation Between Products, Algorithms, Maps, and Alarms. The Government will provide algorithms to detect and measure particular meteorological key events. These algorithms are computational procedures used to derive hazardous weather information from the base radar data. The algorithms must be implemented with contractor provided software to generate the final products. The Government will supply measured wind shear data sets and model wind shear events to the contractor to use in validating the contractor RDA/RPG implementation. The algorithmic output is in a raw form which is not directly usable; that is the algorithmic output must be further processed before it is suitable for distribution to end-users. More than one product may result from a single algorithm. A product will be graphical, alphanumeric, an alarm, or a combination of these. The table below shows the products and their destinations. Graphical product output may be a map showing the location, extent, and perhaps magnitude of a phenomenon or a symbol showing only the location. Alphanumeric product output will take two forms. One form is intended for pilots and will be read and relayed to the pilots by a controller. The second form is for the supervisory controller's use in developing a traffic control strategy. Alarms, in this context, are either visual or audible warnings that a weather hazard, which was not previously reported as being hazardous, has been detected and is in a region of concern to pilots and ATC controllers. The weather product alarms (6.2.1.1) are distinct from maintenance alarms (6.2.1.2) and alerts (6.2.2.2) which are defined in the specification.

PRODUCT DESTINATION

PRODUCT	FORMAT	INTERIM	NAS END-STATE
Microburst	Graphical	SD	TCCC
	Alphanumeric	SD, RBDT	TCCC
	Alarm	SD, RBDT	TCCC
Gust Front	Graphical	SD	TCCC
	Alphanumeric	SD, RBDT	TCCC
	Alarm	SD, RBDT	TCCC
Precipitation	Graphical	SD	none

SD = Situation Display (ATCT, TRACON)
RBDT = Ribbon Display (ATCT, TRACON)
TCCC = Tower Control Computer Complex

1.3.9 Program Support Facility (PSF). A program support facility will be provided at an FAA facility to support the TDWR throughout its operational life as the system software requires upgrades, modification, and maintenance. The PSF will have the capability to read, manipulate, evaluate, and display field recorded base data.

1.3.10 Maintenance Concept. No maintenance specialists will be stationed at TDWR sites. Routine measurements and adjustments will be accomplished remotely through the Remote Maintenance Monitoring System (RMMS). On-site maintenance visits, for preventive (6.2.37) and corrective (6.2.12) maintenance, will occur four times per year on average. In the event of a failure, built in test equipment/built in tests (BITE/BIT) (6.2.9) will identify the probable location of the fault so that the maintenance specialist can bring the appropriate Line Replaceable Units (LRUs) (6.2.25) to the site. The same BITE/BIT used to identify the fault will also be used to verify the system repair. Defective LRUs will be sent to a central Government depot for repair.

2. Applicable Documents. The following documents, of the issue in effect on the date specified in the solicitation, form a part of the specification to the extent specified herein. In the event of a conflict between requirements, the following order of precedence (highest = a) shall apply:

a. This specification and its appendices

b. FAA Specifications and Standards

c. FAA Orders

d. FAA Plans

e. Military Standards

f. Federal Standards

g. Other Documents

2.1 Government Documents.

SPECIFICATIONS:

Federal Aviation Administration

FAA-C-910	Structural Steel
FAA-C-1217	Electrical Work, Interior
FAA-C-2812	Standard Specification, Underground Storage Tank
FAA-C-2454	Facility Site Preparation
FAA-C-2814	Specification for Construction of Large CMU Building for Electronic Equipment
FAA-D-2494	Technical Instruction Book Manuscript
FAA-E-2786	Data Multiplexing Network Equipment
FAA-E-2204	Engine Generator Specification, Diesel Engine Generator sets. 10kW to 300kW.
FAA-G-2100	FAA Electronic Equipment Specification

Military

MIL-E-17555	Electronic and Electrical Equipment, Accessories and Repair Parts: Packaging and Packing of

STANDARDS:

Federal

FED-STD-595	Federal Standards for Colors

Federal Aviation Administration

FAA-STD-016	Quality Control System Requirements
FAA-STD-018	Computer Software Quality Program Requirements
FAA-STD-019	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
FAA-STD-020	Grounding, Transient Protection and Shielding Requirements for Equipment
FAA-STD-028	Standard Contract Training Programs
FAA-STD-032	Design Standards for National Airspace System Physical Facilities

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-280	Definitions of Item Levels, Item Interchangeability, Models and Other Related Items
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference

Military

MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-470	Maintainability Program for Systems and Equipment
MIL-STD-471	Maintainability Demonstration/ Verification
MIL-STD-781	Reliability Design Qualification and Tests
MIL-STD-785	Reliability Program for System and Equipment Development and Production
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-882	System Safety Program Requirements
MIL-STD-889	Dissimilar Metals
MIL-STD-1388-1	Logistic Support Analysis
MIL-STD-1388-2	DOD Requirements for a Logistic Support Analysis Record
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment, and Computer Software
MIL-STD-1561	Provisioning Procedures, Uniform DOD
DOD-STD-1686	Electrostatic Discharge Control Programs for Protection of Electrical and Electronic Parts
DOD-STD-2167	Defense System Software Development

OTHER PUBLICATIONS:

FAA Advisory Circular 70/7460-1	Obstruction Marking and Lighting
FAA Advisory Circular 150/5345-1	Approved Airport Lighting Equipment
DOT/FAA/PM-87-22	TDWR Scan Strategy Description
DOT/FAA/PM-87-23	Microburst Detection Algorithm
DOT/FAA/PM-87-24	Gust Front/Wind Shift Detection Algorithm
DOT/FAA/PM-87-25	TDWR PRF Selection Criteria
DOT/FAA/PM-87-26	TDWR Clutter Residue Map Generation and Usage
DOT/FAA/PM-87-37	Microburst Models for TDWR End to End Simulation Studies
ER/300-87-08-001	TDWR Product Output Formats
FAA Order 1600.54	Security of FAA Automatic Data Processing Systems and Facilities
FAA Order 1800.58	National Airspace Integrated Logistics Support (NAILS) Policy
FAA Order 3900.19	Occupational Safety and Health
FAA Order 3910.3	Radiation Health Hazard and Protection
FAA Order 6000.10	Airway Facilities Service Maintenance Program
FAA Order 6000.27	Maintenance Philosophy Steering Group Requirements
FAA Order 6000.30	Policy for Maintenance of the NAS
NTIA	National Telecommunication and Information Administration Manual of Regulations and Procedures for Federal Radio Frequency Management

OTHER PUBLICATIONS:

OSHA	Occupational Safety and Health Act (29 CFR 1910)
FAA Drawing DR-D-6253	Standard Facility Design Large Concrete Masonry Unit (CMU) Building For Electronic Equipment
NBSIR 87-3524 ICSSC RP-1	Seismic Design Guidelines for Federal Buildings

National Airspace System (NAS)

NAS-IR-22013105	Interface Requirements Document for Tower Control Computer Complex (TCCC) to Terminal Doppler Weather Radar (TDWR)
NAS-MD-790	Interface Control Document (ICD), Maintenance Processor Subsystem to Remote Monitoring Subsystems (RMSs) and Remote Monitoring Subsystem Concentrators (RMSCs)
NAS-MD-792	Operational Requirements for the Remote Maintenance Monitoring Subsystem (RMMS)
NAS-MD-793	Remote Maintenance Monitoring System Functional Requirements for the Remote Monitoring Subsystem (RMS)

2.2 Non-Government Documents.

American National Standards Institute (ANSI)

ANSI A 58.1	Building Code Requirements For Minimum Design Loads in Buildings and Other Structures
ANSI X 3.4	American Standard Code for Information Interchange (ASCII)

Electronic Industries Association (EIA)

EIA-530	High Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment
RS-222	Structural Standards for Steel Antenna Towers and Antenna Supporting Structures
RS-232	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
RS-411	Electrical Characteristics of Earth Satellite Communication Antenna

Bell Publication

62501	Technical Reference, Voice Grade Special Access Service

American Standards Testing Methods (ASTM)

ASTM A-123	Zinc (Hot Galvanized) coatings on products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips.
ASTM A-615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

American Standards Testing Methods (ASTM)

ASTM E-84	Test Methods for Surface Burning Characteristics of Building Materials
ASTM E-136	Test Methods for Vertical Tube Furnace at 750 Degrees C
ASTM G-53	Operating Light-and-Water-Exposure Apparatus Fluorescent UV-CONDENSATION Type for Exposure of Nonmetallic Materials.

American Welding Society (AWS)

D1.1	American Welding Society Structural Welding Code

Aluminum Association (AA)

SAS-30	Specification for Aluminum Structures
ED-33	Engineering Data for Aluminum Structures
WA-20	Welding Aluminum

National Fire Protection Association

NFPA-70	National Electric Code

American Concrete Institute (ACI)

ACI-318	American Concrete Institute Standard Building Code for Reinforced Concrete
ACI-336.2	Suggested Design Procedure for Combined Footings and Mats

Copies of the FAA documents and other applicable FAA specifications, standards, directives, advisory circulars, NAS documents, and drawings may be obtained from the Contracting Officer in the FAA Office issuing the Invitation for Bids or Request for Proposals. Requests should fully identify materials desired; i.e., specifications, standards, amendments and drawing numbers and dates. Requests should cite the Invitation for Bids, Request for Proposals, or the contract involved or other use to be made of the requested material.

Copies of military standards and specifications may be obtained by mail or telephone from the US Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pa. 19120. For Telephone requests call (215) 697-3321, 8 AM to 4:30 PM, Monday through Friday. Not more than 5 items may be ordered on the same request. The applicable Invitation for Bids or contract number should be cited.

Federal Standards documents may be obtained from the Superintendent of Documents, US Government Printing Office, Washington, D.C. 20402.

American National Standards Institute (ANSI) documents may be obtained from ANSI, Inc., 1430 Broadway, New York, N.Y. 10018.

Electronic Industries Association (EIA) documents may be obtained from their Engineering Department, 2001 Eye Street, N.W., Washington, D.C. 20006.

American Standard Testing Methods (ASTM) documents may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pa. 19120.

National Telecommunication and Information Administration documents may be obtained from the National Telecommunications and Information Administration (NTIA) 14th and Constitution, Washington, D.C. 20230, Attn: Publications Officer.

Aluminum Association documents can be obtained from the Aluminum Association, 900 19th Street NW, Washington, D.C. 20006.

American Welding Society (AWS) documents may be obtained from the American Welding Society Structural Welding Code, 550 NW Le Jeune, P.O. Box 351040, Miami,Florida 33135.

Bell Corporation documents may be obtained from Bell Communications Research, 60 New England Ave., Piscataway, N.J., 08854-4196, Attention: Document Coordination.

National Fire Protection document may be obtained from the National Fire Protection Association, Battery Park, Quincy, Massachusetts 02269.

ACI documents may be obtained from the American Concrete Institute, P. O. Box 19150, Redford Station, Detroit, Michigan 48219.

3. Requirements.

3.1 System Definition. The TDWR System includes the radar equipment, facilities, and buildings required to house the equipment, environmental controls, back-up power equipment with associated switching equipment, and the archive recorder. This specification also provides performance requirements for special test equipment (Base Data Recorder and Base Data and Product Display) and a program support facility.

3.1.1 Mission. The primary mission of the TDWR is the timely detection and reporting of hazardous wind shear phenomena, as listed in Appendix A, in and near the terminal approach and departure zones of an airport. The secondary mission to be performed by the TDWR is the prediction of wind shifts and detection of other hazardous weather phenomena as described in Appendix A.

3.1.2 TDWR Products. The TDWR shall produce, communicate, and display the products specified in Appendix A.

3.1.3 System Modes. The TDWR shall have two operational modes, a Monitor mode and a Hazardous Weather mode; and a Maintenance mode.

3.1.3.1 Monitor Mode. The Monitor mode shall consist of 360 degree azimuth scans at various elevation angles from -1 to 60 degrees.

3.1.3.2 Hazardous Weather Mode. The Hazardous Weather mode shall consist of any combination of 360 degree azimuth scans, azimuth sector scans (6.2.43), and range-height indicator (RHI) scans (6.2.41) over any elevation angle range from -1 to 60 degrees.

3.1.3.3 Selection. The TDWR operational modes shall be automatically selected and initiated through the use of the scan strategy algorithm described in Engineering Report DOT/FAA/PM-87-22.

3.1.3.4 Maintenance Mode. The Maintenance mode shall be manually selected or deselected during those maintenance activities which may cause the system to become non-operational. (See 3.1.4.3).

3.1.4 System Functions. The TDWR system is composed of four functional areas, the Radar Data Acquisition (RDA) Function, Radar Product Generation (RPG) Function, Remote Monitoring Subsystem (RMS) Function, and the Display Function. The RDA Function performs the weather detection, clutter handling, and primitive processing subfunctions. The RPG Function performs the weather product generation, RDA scan control, external user output generation, and archiving subfunctions. The RMS Function performs system performance status, monitoring, reporting, maintenance alert and alarm processing, and fault isolation subfunctions. The Display Function performs interim display and control subfunctions. No function shall interfere with the performance of any other function.

3.1.4.1 Radar Data Acquisition (RDA) Function. The RDA Function performs the radar data collection, detection, signal processing, clutter suppression, control, monitoring, and radar data collection error detection and handling subfunctions for the TDWR system.

3.1.4.1.1 Antenna Group.

3.1.4.1.1.1 Antenna Group Dynamic Response. All the requirements for the antenna group (6.2.3) shall be met under the dynamic loads imposed by maximum acceleration.

3.1.4.1.1.2 Main Beam Characteristics. The antenna shall provide a pencil beam no more than 0.5 ±0.1 degree at the half power points in azimuth and elevation. The mainbeam antenna pattern shall fall off monotonically from the beam peak to the -27dB level with respect to the beam peak and this -27dB level point shall occur within ±1 degree in all planes. From this -27dB level point to the ±1 degree point, the antenna pattern in all planes shall be less than -27dB with respect to the beam peak.

3.1.4.1.1.3 Sidelobe Level Control. In any plane, the first sidelobe shall be below -27 dB relative to the peak gain of the main beam. In the region between ±1 and ±5 degrees, the sidelobe level shall be below the straight line connecting -27 dB at ±1 degree and -34 dB at ±5 degrees in all planes. Between ±5 degrees and ±180 degrees, the sidelobe envelope shall average below -40 dB relative to the peak of the main beam. Between ± 5 degrees and ± 180 degrees, the peak of an individual sidelobe may be averaged with the peaks of the two nearest sidelobes on either side, provided that the level of no individual sidelobe exceeds -34 dB and that the combined angular extent of all peaks exceeding -40 dB does not exceed 30 degrees.

3.1.4.1.1.4 Cross Polarization Radiation Levels. The antenna shall, in a plane, maintain the cross polarization radiation at or below the level specified for the sidelobe and backlobe levels of the co-polarized radiation within the angular regions applicable to these lobes. Within the main lobe angular region, the antenna shall maintain the cross polarization component at least 20 dB below the peak of the main beam of the co-polarized radiation.

3.1.4.1.1.5 RF Beam Positioning Accuracy. The Radio Frequency (RF) beam position shall be positioned to within ± 0.05 degrees of the commanded beam position.

3.1.4.1.1.6 RF Beam Positioning Resolution. The resolution of the beam position measurements shall be 0.012 degrees or better.

3.1.4.1.1.7 RF Beam Position Repeatability. The RF beam positioning response to an angle input command shall be repeatable to within ±0.024 degrees of any previous identical angle input command.

3.1.4.1.1.8 Pedestal Elevation Drive. The pedestal elevation drive shall have an acceleration of 15 degrees per second squared and a controllable velocity of 0 to 15 degrees per second in steps no greater than 1 degree per second within an accuracy ±0.5 degrees per second. The elevation drive shall position and hold the antenna within ±0.05 degrees of the selected elevation angle when commanded.

3.1.4.1.1.9 Pedestal Azimuth Drive. The pedestal azimuth drive shall have an acceleration of 15 degrees per second squared and a controllable velocity of 0 to 30 degrees per second in steps no greater than 1 degree per second within an accuracy of ±0.5 degrees per second. The azimuth drive shall position and hold the antenna within ±0.05 degrees of the selected azimuth angle when commanded.

3.1.4.1.1.10 Pedestal Drive Limits. The pedestal shall operate in all the scanning strategies contained in the scan strategy Engineering Report DOT/FAA/PM-87-22 within the time allotted. These strategies include 360 degree azimuth scans, sector scans, and RHI scans from -1 to +60 degrees in elevation.

3.1.4.1.1.11 Duty Cycle. The pedestal shall have a 100 percent duty cycle 24 hours per day for 20 years. The pedestal shall operate continuously with all of the scan strategies in the scan strategy algorithm. The drive system shall be designed on the basis of a 50-50 duty cycle between the monitor and the hazardous weather modes.

3.1.4.1.1.12 Antenna Group Environmental Protection. A radome shall protect the antenna group from environmental conditions.

3.1.4.1.2 Transmitter.

3.1.4.1.2.1 Radio Frequency Operation. The transmitter shall operate in accordance with the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management, Subsection 5.3.2, Criteria C, in accordance with the Radar Spectrum Engineering Criteria (RSEC) for frequency management and electromagnetic compat- ibility on any Government assigned frequency listed in Appendix C.

3.1.4.1.2.2 Klystron. The transmitter shall use a klystron amplifier.

3.1.4.1.2.3 X-Radiation Shielding. X-radiation shielding shall be provided in accordance with FAA-G-2100.

3.1.4.1.2.4 Arc Protection.

3.1.4.1.2.4.1 Transmitter Arc Protection. The transmitter shall be protected against electrical arcing.

3.1.4.1.2.4.2 Waveguide Arc Protection. The waveguide and components carrying high power shall be protected against arcing through the use of monitoring and protection devices. These devices shall prevent the waveguide components of the system, including the klystron, from being physically damaged by arcing.

3.1.4.1.3 Receiver. The receiver shall accept signals from the antenna group, provide required amplification, and detect microwave returns for use by the signal processor.

3.1.4.1.3.1 Receiver Noise Figure Stability. The receiver noise figure shall be maintained within $\pm$ 0.5 dB of the allocated design center value receiver noise figure.

3.1.4.1.3.2 Receiver Performance. The receiver shall meet the requirements of Subparagraph 8 of the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management, RSEC Subsection 5.3.2 (Criteria C).

3.1.4.1.4 Base Data Collection. The RDA shall provide base data which consists of estimates of reflectivity, mean radial velocity, spectrum width, and signal-to-noise ratio at the maximum antenna scan speed (3.1.4.1.1.9).

3.1.4.1.4.1 Sensitivity. The TDWR shall have an overall single-pulse sensitivity such that a -10 dBZ (6.2.14) range bin filling (6.2.40) and beam filling (6.2.7) target provides a +6 dB SNR at a range of 16 nautical miles (nmi).

3.1.4.1.4.1.1 Maximum Detection Range. The TDWR shall produce quantitative reflectivity, velocity, and spectrum width estimates, to the accuracies specified herein, to an unambiguous range of at least 48 nmi.

3.1.4.1.4.1.2 Maximum Detection Range For Reflectivity Estimates. The TDWR shall produce quantitative reflectivity estimates out to an unambiguous range of at least 248 nmi when requested by the RPG.

NOTE: This requirement supports the Pulse Repetition Frequency (PRF) selection algorithm.

3.1.4.1.4.1.3 Minimum Detection Range. The TDWR shall have a minimum detection range of 0.25 nmi or less.

3.1.4.1.4.1.4 Maximum Elevation. The TDWR coverage shall not be required above 70,000 feet above ground level for elevation angles above 2 degrees.

3.1.4.1.4.1.5 Maximum Unambiguous Velocity. The TDWR shall provide an unambiguous estimate of the mean radial velocity (6.2.39) from -40 meters per second (m/sec) to +40 m/sec with unfolding.

NOTE: Hardware/software techniques may be employed to mitigate the effects of velocity aliasing to provide this measurement range.

3.1.4.1.4.2 Dynamic Range. The TDWR shall have an instantaneous (per pulse-per range cell) dynamic range of at least 100 dB.

3.1.4.1.4.2.1 Data Collection Dynamic Range. At all ranges where the system sensitivity permits, the system shall make measurements with the required accuracy on all targets between -20 dBz and +80 dBz.

3.1.4.1.4.3 Radar Data Collection Error Detection. The RDA shall detect errors in the collected data, and flag data values with detected errors so that product generation algorithms may ignore them or provide exception handling as needed. Data errors from at least, but not limited to, the following sources shall be detected:

a. signal processor hardware failure

b. asynchronous RF pulse interference

c. point-target moving clutter (e.g., aircraft, vehicles)

d. ground clutter residue (ref. "Clutter Residue Editing Map")

e. insufficient SNR (set by independent site-adaptable thresholds, for each data field)

f. bias from out-of-trip echoes

g. dealiasing failure

3.1.4.1.4.4 Accuracy. The RDA shall meet the following accuracies while operating over the range of dwell times compatible with the TDWR scan strategies.

NOTE: Degradation of measurement accuracy when ground clutter suppression is enabled is bounded as stated in section labeled "Clutter Bias Error" (3.1.4.1.4.10) and "Clutter RMS Error" (3.1.4.1.4.13).

3.1.4.1.4.4.1 Mean Radial Velocity Measurement. The RDA shall provide an estimate of mean radial velocity with a standard deviation less than or equal to 1 m/sec, including quantization and computational errors, for a true spectrum width (6.2.48) of 4 m/sec and for SNR greater than 8 dB. The resolution of the measurements shall be less than or equal to 0.10 m/sec. The bias error for a true Gaussian spectrum shall be less than 1.0 m/sec for true spectrum widths between 1.0 m/sec and 4.0 m/sec and a SNR greater than 10.0 dB.

3.1.4.1.4.4.2 Reflectivity Measurements. The RDA shall provide an estimate of reflectivity with a standard deviation less than or equal to 2 dB, including quantization and computational errors, for true spectrum widths between 1.0 m/sec and 4.0 m/sec and for SNR greater than 10.0 dB. The resolution of the measurements shall be less than or equal to 1 dB. The bias error for a true Gaussian spectrum shall be less than 2 dB for true spectrum widths between 1.0 m/sec and 4.0 m/sec and a SNR greater than 10.0 dB.

3.1.4.1.4.4.3 Spectrum Width Estimates. The RDA shall provide an estimate of velocity spectrum width (6.2.49). For true spectrum widths between 1 m/sec and 4 m/sec, the standard deviation in the estimate of the spectrum width shall be less than or equal to 1 m/sec, including quantization and computational errors, for a SNR greater than 10 dB. The resolution of the estimate shall be no greater than 0.10 m/sec. The bias error for a true Gaussian spectrum shall be less than 1.0 m/sec for true spectrum widths between 1.0 m/sec and 4 m/sec and for SNR greater than 10.0 dB.

3.1.4.1.4.4.4 Range Error. The error in range placement of base data due to all sources of error shall be less than 50 meters.

3.1.4.1.4.4.5 Signal-to-Noise Ratio Measurements. The RDA shall provide an estimate of the received (first trip) weather signal to noise power ratio with a standard deviation less than or equal to 2 dB, including quantization and computational errors, for true spectrum widths between 1.0 m/sec and 4.0 m/sec, and for SNR greater than 0 dB. The resolution of the measurements shall be no coarser than 1 dB. The bias error shall be less than 2 dB for true SNR greater than 0 dB.

3.1.4.1.4.5 Sample Interval. The following sections define the azimuth, range, and elevation sample interval requirements.

3.1.4.1.4.5.1 Azimuth Sample Interval. The RDA shall provide an azimuth sample interval of no greater than 1.0 degree.

3.1.4.1.4.5.2 Range Sample Interval. The RDA shall provide a range sample interval for reflectivity measurements which is not greater than one-half the cross-range radar beamwidth dimension at the corresponding range, or 150 meters, whichever is larger. In no case shall the range sample interval be greater than one kilometer. This resolution shall include the effects of any range averaging performed. For velocity and spectrum width measurements, a range sample interval not greater than 150 meters shall be provided.

3.1.4.1.4.5.3 Elevation Sample Interval. For RHI scans, the RDA shall provide an elevation sample interval of not greater than 1.0 degree at elevations above 3.0 degrees and a sample interval not greater than 0.5 degrees for elevations less than or equal to 3.0 degrees.

3.1.4.1.4.5.4 Range Resolution. The RDA shall provide a range resolution equal to or finer than the range sample interval (3.1.4.1.4.5.2) at the -3 dB points of the normalized range weighting function.

3.1.4.1.4.6 Antenna Rotation Rate. The RDA shall monitor and control the antenna rotation rate.

3.1.4.1.4.7 Ground Clutter Suppression. The RDA shall provide at least 50 dB of ground clutter suppression for all scan strategies.

3.1.4.1.4.7.1 Ground Clutter Suppression Inhibiting. The RDA shall inhibit ground clutter suppression when it is not required, e.g. high elevation angle scans.

3.1.4.1.4.7.2 No Degradation Due to Inhibiting. There shall be no degradation in weather parameter estimate accuracy when ground clutter suppression is inhibited.

3.1.4.1.4.8 Clutter Suppression Level Maps. The RDA shall generate and utilize site peculiar clutter suppression level maps.

3.1.4.1.4.8.1 Clutter Suppression Level Selection. The RDA shall utilize the clutter suppression level maps, described below, to select either the applicable clutter suppression level from Table I, or no clutter suppression, for each 3 km range interval commencing at the minimum detection range.

3.1.4.1.4.8.2 Plan Position Indicator (PPI) Clutter Suppression Level Maps. The RDA shall utilize PPI clutter suppression level maps for each of the four lowest elevation angles used for azimuth scanning at constant elevation angles. These maps shall be used when scanning horizontally at constant elevation angles.

3.1.4.1.4.8.3 RHI Clutter Suppression Level Maps. The RDA shall utilize RHI clutter suppression level maps for each azimuth angle which may be used by an RHI scan. These maps shall be used when performing RHI scans.

3.1.4.1.4.9 Clutter Residue Editing Maps. The RDA shall provide four PPI clutter residue editing maps extending to 70 km, with range and angular resolution as specified below. The RDA shall generate the four clutter residue editing maps using the clutter editing map algorithm described in Engineering Report DOT/FAA/PM-87-26.

3.1.4.1.4.9.1 Clutter Map Range Resolution. The RDA shall provide a set of four clutter residue editing maps for the base data. If the range sampling intervals are not identical for the various base data, a separate set of four clutter residue editing maps shall be provided for each set of range sampling intervals.

3.1.4.1.4.9.2 Clutter Residue Editing Map Usage. The RDA shall utilize the clutter residue editing maps to flag as invalid all base data products where ground clutter residue has contributed unacceptable data errors. The RDA shall edit the received data using the clutter residue editing maps in accordance with Engineering Report DOT/FAA/PM-87-26.

3.1.4.1.4.9.3 Site Selectable Maps. Each clutter residue editing map shall be independently set for use at site-adaptable elevation angle intervals.

3.1.4.1.4.9.4 Angular Resolution. When the base product coherent processing intervals are repeatable from scan to scan, the clutter residue editing map shall be sampled over the base product angle sampling interval. In all other instances, the clutter residue editing maps shall have an angular resolution of 0.2 beamwidth.

Minimum Usable Mean Radial Velocity, V(min) in meters per second	Clutter Model A in dB (Distributed)	Clutter Model B in dB (Point Target)
2	20	20
3	28	30
4	50	50

Note: Refer to 6.2.21 for Clutter Model A and Clutter Model B.

Table I. Required Ground Clutter Suppression Capability.

3.1.4.1.4.10 Clutter Bias Error. The bias errors of the reflectivity and signal-to-noise estimates caused by clutter suppression devices shall be less than or equal to the values given in Table II.

3.1.4.1.4.11 Base Data Port. The RDA shall provide a bidirectional base data port for recording and playback of base data.

3.1.4.1.4.11.1 Base Data Output. The RDA shall provide base data, and all ancillary data required for playback, at a digital output port, under control of the RMS.

3.1.4.1.4.11.2 Base Data Input. The RDA shall accept base data for playback from a digital input port, under control of the RMS.

3.1.4.1.4.11.3 Base Data Playback. The RDA shall transmit base data from the base data input port to the RPG during playback, in place of actual base data measurements. All subsequent RPG processing on the playback data shall be performed as if the playback data were actual live measurements.

3.1.4.1.4.12 Test Signal Injection. The RDA signal processing shall provide an alternate data input path for the processing of simulated test data to exercise the complete set of RDA signal processing subfunctions.

3.1.4.1.4.13 Clutter RMS Error. The base data standard deviation accuracies and resolution requirements stated in paragraphs 3.1.4.1.4.4.1, 3.1.4.1.4.4.2, 3.1.4.1.4.4.3, and 3.1.4.1.4.4.5, shall be met for all weather velocities above the minimum usable velocity (6.2.33) when clutter suppression is enabled.

3.1.4.1.5 Transmitter-Receiver Chain Stability. The transmitter-receiver chain shall possess stability at the input of the digital signal processor such that the integrated instability residue generated by a stable input test signal is more than 55 dB down from the stable portion of the input signal at the input of the signal processor. The test signal waveform(s) utilized for stability testing shall be identical to that (those) used at the elevation angles where clutter suppression is selected.

NOTE: For the purposes of this requirement, the integrated instability residue consists of the sum of the amplitudes of all frequency components except those in the band between -10 Hertz (Hz) and +10 Hz.

Weather Spectrum Width (m/sec)	Maximum Allowable Bias in Reflectivity and Signal-to-Noise Estimate (dB)
1	18
2	7
$\geq$ 3	5

Note: The bias is measured with an input S/C of at least 30 dB. It applies for all mean radial velocities less than the minimum usable velocity (6.2.33) and shall be systematically predictable from mean radial velocity and spectrum width parameters of the Gaussian random process weather model. The bias for velocities greater than the usable velocity shall be less than 2.0 dB.

Table II. Maximum Allowable Bias in Reflectivity Estimates Due to the Clutter Suppression Device.

3.1.4.1.5.1 Stability Test Input Signal. The RDA shall provide a delayed attenuated transmitter signal having a delay of at least 3 microseconds as the stable input test signal.

3.1.4.1.5.2 Stability Test Equipment. The RDA signal generation and analysis system dynamic range and linearity shall support measurement of an instability residue of 60 dB down from the stable portion of the test signal.

3.1.4.1.5.3 Stability Test Points. The RDA shall provide test points to access all frequency sources in the transmitter-receiver chain with the system installed in the field.

3.1.4.1.6 Moving Target Simulator. A moving target simulator shall be provided to simulate an equivalent weather target cross section of 50 dBz when installed at a remote site at ranges from 2 to 20 kilometer (km) from a TDWR system when the beam is centered on the bearing of the weather target simulator. The simulated weather target cross section repeatability shall be ± 1 dB.

3.1.4.1.6.1 Equivalent Target Velocity. The equivalent weather target shall have a mean radial velocity of + 5 m/sec ± 0.1 m/sec.

3.1.4.1.6.2 Carrier. The moving target simulator output shall be single side band suppressed carrier with undesired components (i.e. all components not associated with the Doppler shift of 5 m/sec) suppressed at least 20 dB below the desired signal. The undesired component at the carrier frequency (i.e., the component associated with a Doppler shift of 0 m/s) shall be suppressed at least 5 dB below the desired signal.

3.1.4.1.6.3 Azimuth Adjustment. The moving target simulator radiating elements shall be adjustable in azimuth over a range of 90 degrees.

3.1.4.1.6.4 Elevation Adjustment. The moving target simulator radiating elements shall be adjustable in elevation over a range of 45 degrees centered on the horizon.

3.1.4.1.6.5 Elevation Adjusters. The moving target simulator shall have an elevation adjuster for each radiating element.

3.1.4.1.6.6 Configuration. The moving target simulator shall be configured as a single unit requiring no field connection of RF cables. All components including the radiating elements shall be protected from the environment.

3.1.4.1.6.7 Electrical Power. The moving target simulator shall be powered from a 60 Hz, 120 VAC commercial source and shall consume 100 watts or less. The operating range shall be at least 102v to 138v and 57 Hz to 63 Hz.

3.1.4.1.6.8 Moving Target Simulator Usage. The TDWR shall use the moving target simulator to provide a check of the TDWR main beam and to provide a check of overall radar performance.

3.1.4.1.7 Time Series Port. The in-phase and quadrature (I and Q) outputs of the Analog-to-Digital (A/D) converter together with Automatic Gain Control (AGC) scaling information (if an AGC is used), and the associated range interval and antenna position data shall be available at a digital output port.

3.1.4.2 Radar Product Generation (RPG) Function. The RPG functional area shall include all hardware and software required for control command generation, real time product generation, product and data storage, and product distribution.

3.1.4.2.1 Not Used.

3.1.4.2.2 Real Time Product Generation.

3.1.4.2.2.1 Algorithm Implementation. The RPG shall implement meteorological algorithms.

3.1.4.2.2.2 Product Generation. The RPG shall generate products in accordance with the requirements of Appendix A.

3.1.4.2.2.3 Product Priority. The RPG shall create and distribute products in accordance with the priorities of Appendix A.

3.1.4.2.2.4 Radar and Maintenance Data Identification. The RPG shall provide an unambiguous identification to both radar and maintenance data.

3.1.4.2.3 Site Dependent Data. The RPG shall accept and store site dependent data from the RMS. The adaptation data shall include but not be limited to:

a. latitude, longitude, site elevation

b. Not Used.

c. alarm (6.2.1) and alert (6.2.2) parameters that are site dependent

d. algorithm parameters that are site dependent

e. sector blanking parameters

f. clutter suppression level maps

g. information necessary to relate products to runway or other geographic locations.

3.1.4.2.3.1 Site Dependent Data Retention. The RPG shall retain site dependent data during power loss and all maintenance activities including LRU Replacement.

3.1.4.2.4 Data Archiving. The RPG shall provide for the archiving of five or more sets of the last sixty (60) minutes of generated products, system status messages, and end-user inputs. All data shall be tagged with Julian date, hour, minute, and second.

3.1.4.2.4.1 Product and Data Storage. The RPG shall store on-line the last hour of data required for archiving and retain this data during power loss and maintenance activities.

3.1.4.2.4.2 Archive Request. The RPG shall archive, to a transportable permanent storage medium, the data required for archiving within sixty (60) seconds of receipt of an archive data command.

3.1.4.2.4.3 Archived Data Erasing. The RPG shall not erase or overwrite the archived data except in response to explicit physical and software actions, such as password entry and mechanical switching.

3.1.4.2.5 Control.

3.1.4.2.5.1 Operating Mode Select. The RPG shall monitor and control the operating mode and scanning strategy of the TDWR in accordance with the scan strategy algorithm.

3.1.4.2.5.2 Pulse Repetition Frequency (PRF) Selection. The RPG shall automatically select transmitter PRF to minimize obscuration within user specified range/azimuth sectors due to out-of-trip weather echoes. The selection shall be in accordance with Engineering Report DOT/FAA/PM-87-25 and shall be selected from a finite set of PRF values. The set of PRF values shall allow for at least a 50 km total variation in the basic unambiguous range interval, and consist of range increments of no greater than 3 km.

3.1.4.2.5.3 Programmable Sector Blanking. The RPG shall provide for sector blanking of the transmitter and the receiver programmed from the RMS.

3.1.4.2.5.3.1 Sectors. The RPG shall provide for the blanking of up to eight azimuth sectors.

3.1.4.2.5.3.2 Sector Azimuth Selection. The size of the azimuth sectors shall be between 0 and 360 degrees in azimuth and shall be selectable in one degree increments.

3.1.4.2.5.3.3 Sector Elevation Selection. Blanking shall be inhibited above a selectable elevation from -1 degree to +60 degrees with a resolution of 0.1 degrees for each blanked azimuth sector.

3.1.4.2.5.4 Data Collection. The RPG shall collect and store all the data necessary to meet the system performance requirements.

3.1.4.2.5.5 Not Used.

3.1.4.2.5.6 Not Used.

3.1.4.2.5.7 Not Used.

3.1.4.2.5.8 Not Used.

3.1.4.2.5.9 Standard Time Source. Upon command, the RPG shall set its internal clock.

3.1.4.2.5.9.1 Internal Clock. The RPG shall contain an internal battery backed (float charged) clock with an accuracy of 1 second per month.

3.1.4.2.6 Interface Ports. The TDWR shall send graphic and alphanumeric data from the RPG functional area to external NAS subsystems.

3.1.4.2.7 Base Display Generation. The RPG shall format selected base data and product information and transmit to the Base Data Display port for the portable base data and product display test unit (3.5.1.7.1).

3.1.4.3 Remote Monitoring Subsystem (RMS) Function. The RMS function is an integral part of both the RMMS, not a part of this specification, and the TDWR System. The RMS function shall implement the requirements of NAS-MD-790, NAS-MD-792, NAS-MD-793, and this specification.

3.1.4.3.1 System Status/Performance Monitoring and Control. The RMS shall monitor and control TDWR status, performance, and adaptation parameters. RMS reported parameters shall be in units which may be directly and easily used by a maintenance technician. Units used for each parameter require Government approval.

3.1.4.3.2 Monitoring. The RMS shall monitor TDWR hardware and software performance, including RMS performance.

3.1.4.3.2.1 Alarm/Alert Processing. The RMS monitoring shall determine out-of-tolerance conditions and automatically classify each out-of-tolerance condition as an alarm or an alert.

3.1.4.3.2.2 Alarm/Alert Parameters. The RMS shall set and change, on command, the range of selected parameters used to determine out-of-tolerance conditions for the declaration of an alarm or an alert.

3.1.4.3.2.3 Alarm/Alert Disabling. The RMS shall provide for the disabling of alarm or alert declarations for individual parameters from the local Maintenance Data Terminal (MDT) in the maintenance mode. Alarm and alert disabling shall not be allowed remotely.

3.1.4.3.2.3.1 Alarm/Alert Enabling. The RMS shall enable alarm and alert processing when returning to an operational mode.

3.1.4.3.2.4 Alarm/Alert Disable Reporting. The RMS shall report the disabling of an alarm or alert as a part of that parameter's performance data.

3.1.4.3.2.5 RMS Alarm/Alerts. The RMS shall report as an alarm or an alert any condition which affects critical system performance or data integrity to include, but not be limited to, the following:

a. Transmitter voltage out-of-tolerance

b. Transmitter current out-of-tolerance

c. Transmitter peak power out-of-tolerance

d. Transmitter output average power out-of-tolerance

e. Voltage Standing Wave Ratio (VSWR) out-of-tolerance

f. PRF out-of-tolerance

g. Modulator overload

h. Klystron driver power out-of-tolerance

i. Klystron temperature out-of-tolerance

j. Klystron cooling system failure

k. Waveguide pressurization out-of-tolerance (if used)

l. Receiver sensitivity out-of-tolerance (1 dB or greater)

m. System noise figure out-of-tolerance

n. Instability residue level out-of-tolerance

o. Clutter suppression performance out-of-tolerance

p. Weather parameter estimation performance out-of-tolerance

q. Internal power supply out-of-tolerance

r. Primary power voltage, on any phase, out-of-tolerance

s. Primary power frequency drift out-of-tolerance

t. Cabinet temperature out-of-tolerance

u. Pedestal lubrication or cooling system failure or both

v. Azimuth pointing accuracy out-of-tolerance

w. Antenna drive motor(s) current and temperature out-of-tolerance

x. Waveguide arcing

y. Radome integrity (inflatable only)

z. Intrusion (facility)

aa. Fire

ab. Smoke

ac. Cooling air flow failures

ad. Timing checks

ae. RDA errors

af. Central Processing Unit (CPU) errors

ag. Memory errors

ah. RPG errors

ai. Situation display failures

aj. Ribbon display failures

ak. Communications failure and errors

al. Facility Heating, Ventilation and Air Conditioning (HVAC) System failure

am. Ambient Air Temperature (internal) out-of-tolerance

an. Engine Generator (E/G) room temperature out-of-tolerance

ao. Battery No-Load/Cranking Load out-of-tolerance

ap. E/G temperature out-of-tolerance

aq. E/G oil pressure out-of-tolerance

ar. E/G over cranking

as. E/G speed out-of-tolerance

at. E/G fuel level out-of-tolerance

au. E/G fuel leakage

av. Aircraft Obstruction Light Lamp Failure

3.1.4.3.2.6 RMS Independence. The RMS shall independently monitor and transmit performance data.

3.1.4.3.3 Local Data File. The RMS shall maintain status and performance data, to include certification test data (6.2.11), in a local data file to include at least all critical performance parameter data, the last 6 maintenance alarms, the last 6 alerts, and a time date tag for each entry.

3.1.4.3.4 Data Report. The RMS shall provide data from the local data file to other RMMS subsystems (6.2.36) in accordance with NAS-MD-790.

3.1.4.3.5 Operating Status. The TDWR operating status data shall include configuration and mode of operation.

3.1.4.3.6 System Status Report. The RMS system status report shall contain only mode changes, alarms, and alerts.

3.1.4.3.7 Parameter Reporting. The RMS shall report, on command, preselected groupings of parameter values or the entire list of parameter values in accordance with NAS-MD-790. In addition to all other monitored parameters, outside air temperature shall be monitored and reported when selected.

3.1.4.3.8 Time Tag. The RMS shall tag each product with the time and date of generation and transmission with 6 decimal digits depicting day, hour, and minute.

3.1.4.3.9 Return-To-Normal Message. The RMS shall generate a return-to-normal message when an alarm or an alert condition is cleared.

3.1.4.3.10 MDT Local Control. The RMS shall disable, and enable the RMMS commands under control of the MDT.

3.1.4.3.11 Diagnostic Test Data. The RMS shall monitor and control internal diagnostic Built In Tests/Fault Isolation Tests (BIT/FIT) (6.2.8) including those which isolate faults, verify performance, or determine backup equipment availability.

3.1.4.3.12 Facility Data. The RMS shall monitor and control facility electrical power systems and HVAC systems.

3.1.4.3.12.1 Engine-Generator Control. The RMS shall control the engine-generator to start, stop, and switch electrical power to the engine-generator.

3.1.4.3.13 Control Commands. The RMS shall execute control functions upon receipt of valid commands from other RMMS subsystems.

3.1.4.3.14 RMS Mode Change. The RMS shall override automatic mode selection and manually select a mode when commanded.

3.1.4.3.14.1 Return to Automatic Selection. The RMS shall return the RPG to automatic mode selection when commanded.

3.1.4.3.14.2 Monitor Mode. The RMS shall select the monitor mode only when the TDWR is in the maintenance mode.

3.1.4.3.14.3 System On/Off. The RMS shall turn the TDWR equipment on/off as commanded.

3.1.4.3.15 Parameter Adjustment. The RMS shall execute commands to adjust site dependent parameters, including invoking an update of the clutter residue editing map.

3.1.4.3.16 Reset. The RMS shall provide a reset command to return the TDWR to a predetermined configuration.

3.1.4.3.17 Control and Monitoring of Redundant Equipment. The RMS shall control and monitor all redundant equipment.

3.1.4.3.18 RMS Control. Unless otherwise specified, the control of the RMS shall be from both a MDT port and the RMMS port.

3.1.4.3.19 Mode Monitoring. The RMS shall monitor the mode and the configuration of the TDWR.

3.1.4.3.20 Setting of Internal Clock. The RMS shall set the RPG internal clock within 0.1 seconds of receipt of command. Time shall be entered to the nearest second.

3.1.4.3.20.1 Time Report. The RMS shall report month, day, hour, and second when commanded.

3.1.4.3.21 Transmission Cutoff. The RMS shall inhibit TDWR radio frequency transmissions when the antenna becomes stationary for more than 5 seconds. The RMS shall override the radio frequency transmission cutoff when commanded by other RMMS subsystems.

3.1.4.3.22 Base Data Port Operation. The RMS shall control the recording and playback of base data as follows:

a. Start/stop recording on the recorder.

b. Skip forward on the recorder a specified time interval.

c. Skip backward on the recorder a specified time interval.

d. Start/stop playback on the recorder.

e. Monitor recorder status to include recording on/off, playback on/off, and time remaining indication.

3.1.4.3.23 Time Series Port. The RMS shall control the output of time series data (6.2.47) from the time series port.

3.1.4.3.24 Input/Output Port. The RMS shall provide an input/output port for the MDT.

3.1.4.3.24.1 Data Input. The RMS shall accept local data input from the MDT.

3.1.4.3.24.2 Data Display. The RMS shall provide data to the MDT.

3.1.4.3.25 Message Transfer. The RMS shall transfer messages between the MDT and either a Remote Monitoring Subsystem Concentrator (RMSC) or a Maintenance Processor Subsystem (MPS) or both as specified in NAS-MD-790.

3.1.4.3.26 Certification Test (6.2.10). Upon RMMS command, the RMS shall execute performance tests to verify that the TDWR is operating within operational specifications.

3.1.4.3.26.1 Certification Test Data. The RMS shall obtain, and store in the local data file, certification test data that include values of all internal operating parameters required for certification of the TDWR.

3.1.4.3.27 Performance Characteristics. The RMS performance characteristics are defined in the following paragraphs. The maximum times are the 99th percentile response times.

3.1.4.3.27.1 Alarm/Alert Detection. The RMS shall detect alarm and alert conditions, filter extraneous fluctuations to prevent false alarms and alerts, and provide an indication to the local data file within an average time of 2 seconds and a maximum time of 10 seconds from the time the alarm or alert condition occurs.

3.1.4.3.27.2 Change of Operational Mode Detection. The RMS shall detect a change of operational mode/configuration, and provide an indication to the local data file within an average time of 2 seconds and a maximum time of 10 seconds from the time the change occurs.

3.1.4.3.27.3 Performance Data Report. The RMS shall collect certification test data, diagnostic test data, monitored parameter data, and facility data for a single report. The data shall be collected within an average time of 50 seconds and a maximum time of 4 minutes from the time the RMS starts collecting the data.

3.1.4.3.27.4 Control Commands. The RMS shall execute control commands, received from other RMMS subsystems, that cause a change of mode or configuration within an average time of 2 seconds and a maximum time of 5 seconds from the time the RMS receives the control command.

3.1.4.3.27.5 Command Acknowledgment. The RMS shall transmit an acknowledgment of receipt of a valid command within an average time of 2 seconds and a maximum time of 5 seconds from the time the RMS receives the command.

3.1.4.3.27.6 Message Transfer. The RMS shall provide for the transfer of MDT messages of up to 4000 characters within an average time of 50 seconds and a maximum time of 100 seconds from the time the last character of the message is available for transmission.

3.1.4.3.27.7 Not Used.

3.1.4.3.27.8 Message Priority. The RMS shall transfer messages to the other RMMS subsystems on a priority basis with the order of priority as specified in NAS-MD-790.

3.1.4.3.28 Command Subset. Commands which can affect product integrity or system performance shall be executed only in the TDWR maintenance mode.

3.1.4.3.29 Equipment Protection. The RMS shall ensure that the TDWR equipment does not experience additional damage following an initial failure.

3.1.4.3.29.1 RMS Fault Protection. Any failure in the RMS shall not disrupt TDWR weather processing nor affect operational performance.

3.1.4.3.30 Protection from Improper Command. The RMS shall prevent equipment damage or loss of data when an improper command is issued.

3.1.4.3.30.1 Protection from Inadvertent Mode Change. The RMS shall prevent the inadvertent change of operational modes due to casual keyboard entry or lack of entry.

3.1.4.4 Display Function. The display functional area provides for interim end-user display, control, and processing functions to be utilized during the NAS transition to the ACCC/TCCC.

3.1.4.4.1 System Control. The display function shall request data archiving.

3.1.4.4.2 Display Functional Unit. A TDWR system shall support up to two display functional units (DFU). A DFU shall be composed of one situation display and zero to eight ribbon displays.

3.1.4.4.2.1 Situation Display. The situation display shall display alphanumeric and graphic products, equipment status, TDWR mode, archive status, and active runway configuration as follows:

a. alphanumeric and graphic products - see Appendix A

b. equipment status

(1) normal (no alert or alarm)
(2) maintenance alarm

c. TDWR mode

(1) Hazardous Weather
(2) Monitor
(3) Maintenance

d. archive media status

(1) full
(2) hours remaining
(3) empty

e. active runway configuration

3.1.4.4.2.1.1 Equipment Requirements. Each situation display shall meet the requirements of Appendix B.

3.1.4.4.2.2 Ribbon Display. The ribbon display shall display alphanumeric products in accordance with Appendix A and provide a positive indication of equipment status.

3.1.4.4.2.2.1 Equipment Requirements. Each ribbon display shall meet the requirements of Appendix B.

3.1.4.4.2.3 DFU Communication. Each DFU shall communicate with the RPG through 9600 baud paths. Communication between two DFUs will be through Government Furnished Equipment (GFE) modems except where the tower and TRACON are collocated in the same facility. The paths will be equivalent to Voice Grade 7 Bell Publication 62501, Technical Reference, Voice Grade Special Access Service.

3.1.4.4.2.3.1 DFU Spare Port. Each DFU shall provide a spare output port which provides a copy of the corrected data received from the RPG with a maximum delay of one second.

3.1.4.4.2.4 Verification. The DFU shall detect defective and missing messages and either correct the message or have the message retransmitted. Only verified and current messages shall be displayed.

3.1.4.4.2.5 Backup of Communications. The DFUs shall support redundant communication between pairs of DFUs. A failure, or the non-existence of, the path between the two DFUs shall not affect the operation of either of the DFUs. When the path between two DFUs is operational, full operation with no degradation shall be provided in the event that a single path between the RPG and a DFU fails or degrades.

3.1.4.4.2.6 Alternate Communications Configuration. Each DFU shall accept two paths to the RPG and shall automatically switch to the path providing the most complete and error free transmissions. Communication between DFUs is not required in this configuration.

3.1.4.4.2.7 Ribbon Message Destination. The DFU shall execute commands from the situation display to send ribbon display alphanumeric messages to specific ribbon displays.

3.1.4.4.2.7.1 Runway Reference. Messages containing runway references shall be sent to specific ribbon displays when so commanded from the situation display.

3.1.4.4.2.7.2 No Runway Reference. Messages not containing runway references shall be displayed on all ribbon displays.

3.1.4.4.3 Hazardous Weather Warnings. The display function shall produce audible and visual alarms when a weather product alarm is received.

3.1.5 System Functional Relationships. The TDWR system functional relationships are depicted on Figure 1.

3.1.6 Configuration Allocation. Reserved.

3.1.7 Interface Requirements.

3.1.7.1 External Interface.

3.1.7.1.1 External Systems Description. The TDWR will interface with the following external systems.

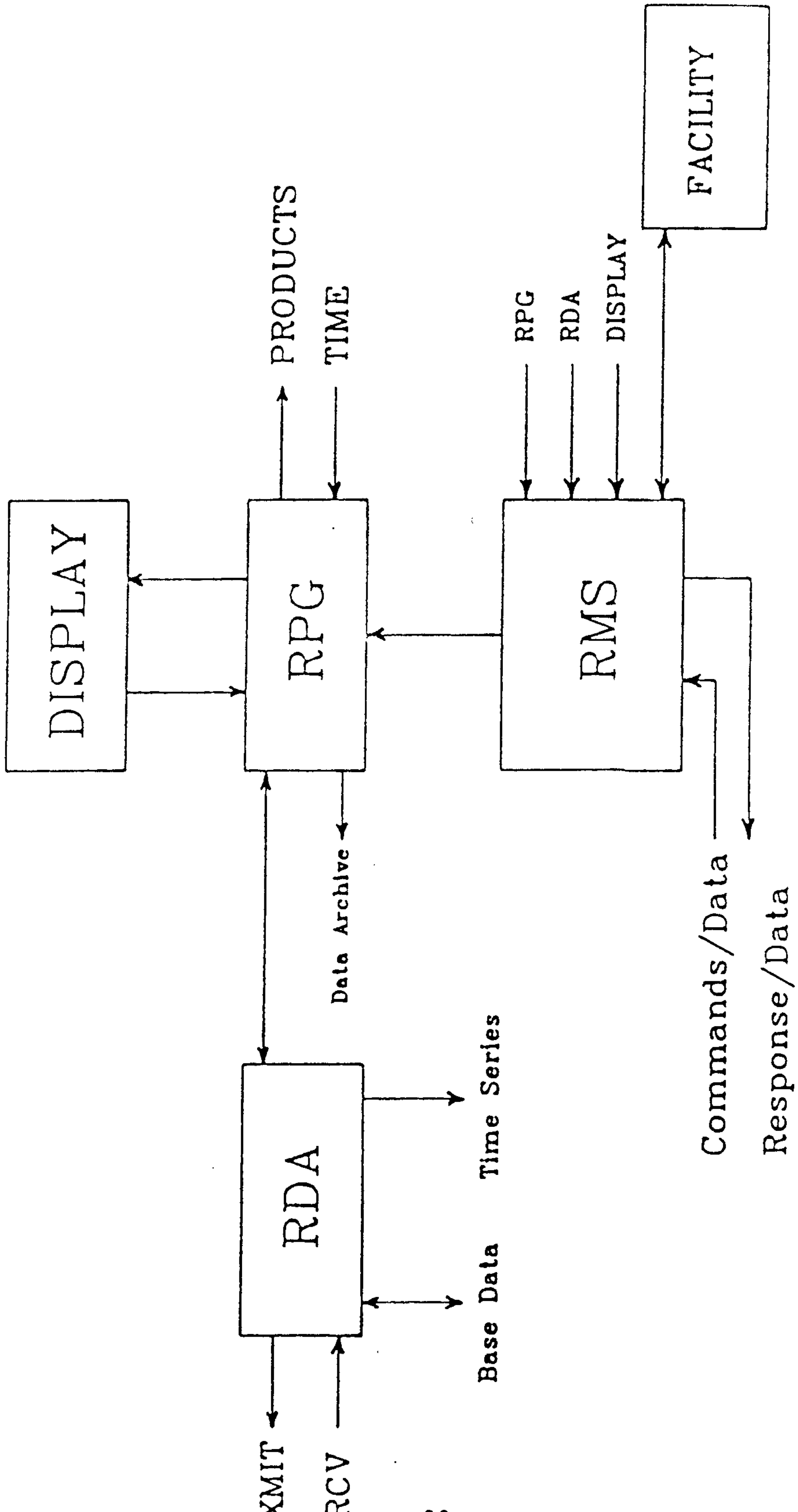

Figure 1. System Functional Relationships

3.1.7.1.1.1 Not Used.

3.1.7.1.1.2 Tower Control Computer Complex. The TDWR shall interface with the TCCC for transmission of products, equipment status, TDWR modes, and receipt of commands. The TCCC will provide dissemination of product data to appropriate ATC facilities.

3.1.7.1.1.3 Low Level Wind Shear Alert System (LLWAS). Reserved.

3.1.7.1.1.4 Air Traffic Control Tower. The TDWR shall interface with the ATCT through the DFU. This TDWR interface handles the interim display/control requirements for ATC personnel.

3.1.7.1.1.5 Terminal Radar Approach Control Facility. The TDWR shall interface with the TRACON through the DFU. This TDWR interface handles the interim display/control requirements for ATC personnel.

3.1.7.1.1.6 Remote Maintenance Monitoring System. The TDWR shall interface with the RMMS for the transmission of maintenance data and messages and for the receipt of commands and messages. The RMMS will remotely control and monitor the maintenance status of the TDWR.

3.1.7.1.1.6.1 Maintenance Data Terminal. The TDWR shall interface with the MDT, a part of the RMMS, for local on-site control and monitoring of maintenance activities.

3.1.7.1.1.7 Base Data Recorder. The TDWR shall interface with a Base Data Recorder for the recording, playback, and control of base data.

3.1.7.1.1.8 Time Series. The TDWR shall interface with a Time Series Recorder for the recording and control of I and Q data.

3.1.7.1.1.9 Base Data and Product Display. The TDWR shall interface with a PPI portable Base Data and Product Display for selective displaying of base data.

3.1.7.1.2 External Interface Identification. The TDWR external interfaces are defined in Figure 2.

3.1.7.1.3 Hardware-to-Hardware External Interfaces. The physical level protocol shall provide the electrical and mechanical interface between the TDWR and the other NAS subsystems.

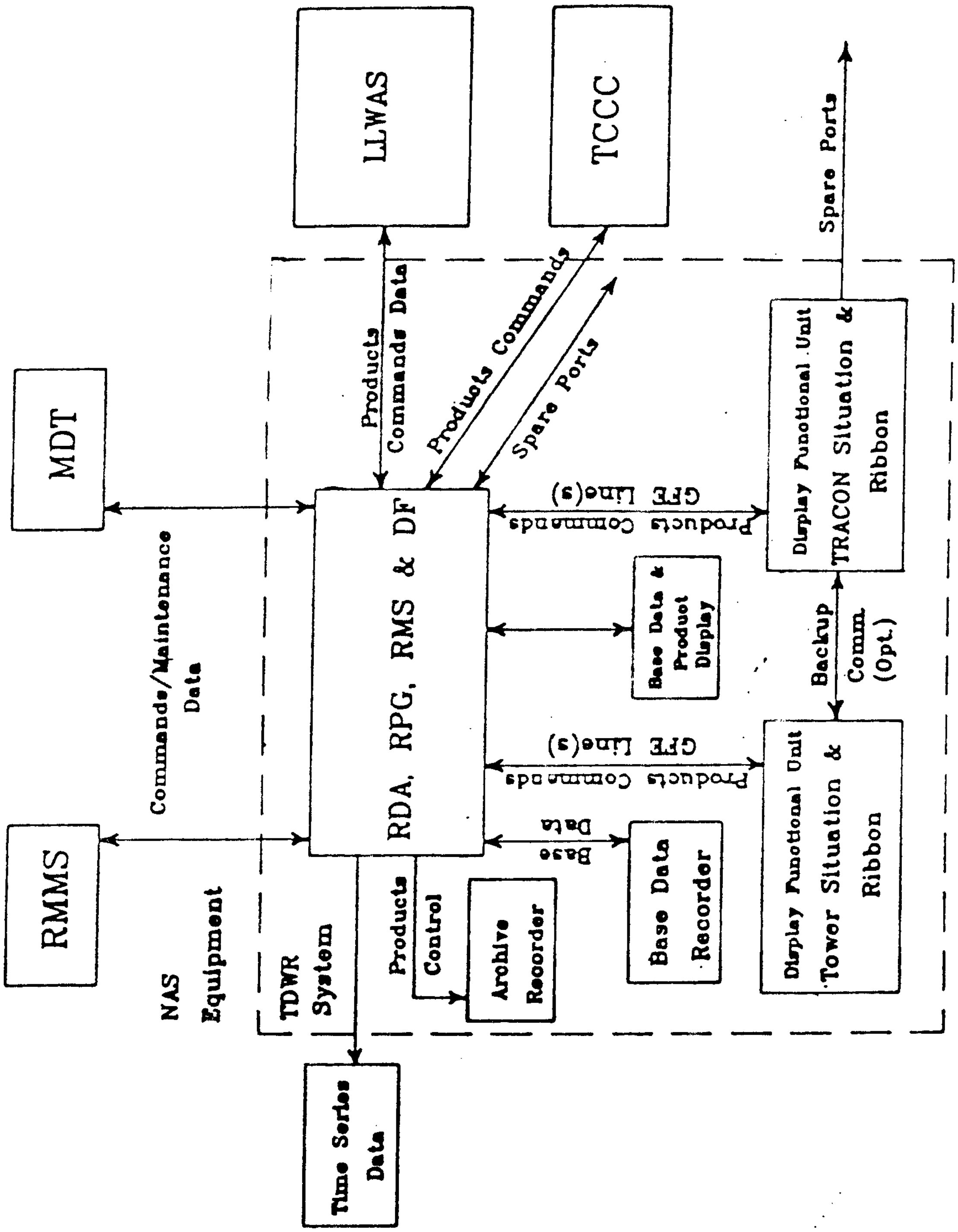

Figure 2. External Interfaces

3.1.7.1.3.1 Physical Protocol. The physical level protocol shall support the following interfaces:

a. RS-232
b. EIA-530

3.1.7.1.3.2 Communication Port Requirements.

3.1.7.1.3.2.1 Interface Configuration. The TDWR communications ports shall be defined:

a. Reserved

b. NAS-IR-22013105 (IRD for TCCC)

c. NAS-MD-790 (ICD for RMMS)

d. MDT Port

e. LLWAS (Reserved)

f. ATCT DFU port (supplied by contractor)

g. TRACON DFU port (supplied by contractor)

h. (9) Spare ports

i. Base Data Port (supplied by contractor)

j. Time Series port (supplied by contractor)

k. Base Data Display port (supplied by contractor)

3.1.7.1.3.2.2 Communication Port Flexibility. Each of the TDWR ports shall be configurable to any of the specified configurations except for three ports: one port shall be configured as a base data port, one port shall be configured as a time series port, and one port shall be configured as a base data display port.

3.1.7.1.3.2.3 DFU Communications Ports. The DFU shall provide one spare port.

3.1.7.1.3.3 MDT Port. The MDT Port shall be RS-232, asynchronous, 300, 1200, 2400, 4800, and 9600 baud, ASCII 7-bit code as specified in ANSI X3.4.

3.1.7.1.4 Hardware-to-Software External Interface. This section is not applicable to this specification.

3.1.7.1.5 Software-to-Software External Interface. The software communication with other NAS subsystems shall be implemented in accordance with this specification.

3.1.7.2 Internal Interface. To be supplied by contractor.

3.1.8 Government Furnished Property List.

3.1.8.1 Government Furnished Information (GFI).

3.1.8.1.1 Airport Information Charts. For each facility place-name identified in the contract schedule, the Government will furnish applicable airport information, as available.

3.1.8.1.2 Airport Data Package. The Government will provide the following data for each facility place-name identified in the contract schedule:

a. An index which includes all drawings, titles, and numbers (e.g., airport master plan, cable routings, conduits under runways, utilities, ATCT).

b. FAA Facilities General Layout Plan.

c. ATCT equipment room layouts, console layout, and cable routes as may be required for installation of the display(s).

3.1.8.1.3 Weather Test Cases. The Government will provide a set of base data measurements for use in the development and testing of the TDWR system. This data will be provided on magnetic tape media, in the standard format for the exchange of meteorological radar data. A variety of weather cases will be provided, to include examples of all those phenomena to be detected and processed by the operational algorithms, including microbursts, gust fronts, and long range storms (for PRF selection algorithm testing). This data will have been obtained using radar systems similar, but not identical to, the TDWR radar, and will be adequate for the verification of all Government-supplied algorithms. These data cases will not, in all cases, be free from contamination caused by ground clutter interference, velocity aliasing, and out-of-first-trip echo obscuration. Each test case provided will be accompanied by a description of the synoptic situation present, as well as the significant TDWR related phenomena in the data. Detailed specification of the correct Government-supplied algorithm outputs for each case will be provided.

3.1.8.1.4 Not Used.

3.1.8.1.5 Not Used.

3.1.8.1.6 Site Radio Frequency (RF) Assignments. The Government will provide RF assignments for each site.

3.1.8.2 Government Furnished Property (GFP).

3.1.8.2.1 Land Acquisition. All land acquisition that is required for the establishment of the facility will be accomplished by the Government.

3.1.8.2.2 Right-of-Way. The Government will acquire permanent right-of-way for access roads, power lines, and telephone lines. The Government will negotiate licenses and leases.

3.1.8.3 Government Furnished Equipment

3.1.8.3.1 Modems. The Government will furnish necessary modems for RPG to DFU, DFU to DFU, TDWR to RMMS, and TDWR to TCCC communications. These modems will conform to FAA-E-2786 and EIA-530.

3.1.8.3.2 Engine-Generator. The Government will furnish an engine-generator, an exhaust silencer, dry charged batteries with electrolyte, a load bank, a transfer switch, and a bypass switch for each site.

3.1.8.3.3 Dedicated Communication Lines. The Government will furnish all dedicated communication lines.

3.2 System Characteristics.

3.2.1 Physical Requirements.

3.2.1.1 General Physical System Requirements.

3.2.1.1.1 Not Used.

3.2.1.1.2 Not Used.

3.2.1.1.3 LRU Level. LRUs shall be established at the printed wiring board or module (6.2.34) level.

3.2.1.1.4 Not Used.

3.2.1.1.5 Panel Controls. The TDWR equipment shall provide controls that meet the requirements of FAA-G-2100.

3.2.1.1.5.1 Locking Devices

3.2.1.1.5.1.1 Critical Controls. All controls critical to proper equipment function shall include locking devices.

3.2.1.1.5.1.2 Operation of Locking Devices. The operation of the locking devices shall not disturb the setting of the control.

3.2.1.1.5.2 Access. All controls shall be accessible on the front of each equipment unit or shall be immediately available from the top of the unit upon withdrawing the sliding chassis.

3.2.1.1.6 Mechanical. All TDWR equipment shall be constructed so that fixed parts do not become loose, movable parts and adjustment settings do not shift in position, and performance does not degrade if subject to the following conditions:

a. Operating - Normal operating conditions.

b. Storage - Storage for a period of two years.

c. Transportation - Sustain transportation shock and vibration when relocating equipment from one site to another by commercial truck.

3.2.1.1.7 Not Used.

3.2.1.1.8 Nameplates And Product Marking. Name plates shall be provided in accordance with FAA-G-2100 except that each shall include gross weight (6.2.20).

3.2.1.1.9 Physical Security. All equipment not housed in a secured building or structure shall be provided with a method of being physically secured, e.g. lockable buildings, locked perimeter fences, to prevent access by unauthorized personnel, tampering, and vandalism.

3.2.1.1.9.1 Intrusion Alarm. The TDWR shall provide an intrusion alarm, with a 60 second delay, for warning of intrusion into the TDWR facility or shelters.

3.2.1.1.10 Convenience Outlets. As a minimum, two grounded, duplex, convenience outlets, equipped with a ground fault interrupter, protected by a circuit breaker, with parallel slots and double sided contacts, rated at 20 amperes (amps), 120 volts AC (VAC), shall be provided with each equipment cabinet, in accordance with FAA-G-2100.

3.2.1.1.11 Hoists and Lifts. Hoists and lifts shall be provided as required for routine maintenance.

3.2.1.1.12 Lighting. Lighting shall be provided in and around areas requiring maintenance activity, e.g., cabinets, pedestal and radome. Lighting shall be sufficient to meet the requirements of MIL-STD-1472.

3.2.1.1.13 Lightning Protection. The TDWR shall be protected from lightning strikes in accordance with FAA-STD-019 and FAA-STD-020.

3.2.1.2 Radome Physical Requirements.

3.2.1.2.1 Radome Effects. The TDWR shall meet all requirements in this specification with the radome installed.

3.2.1.2.2 Radome Enclosure. The radome shall provide an environmental enclosure.

3.2.1.2.3 Internal and External Surfaces. The radome weathering capability shall be in accordance with ASTM G-53.

3.2.1.2.4 Water Penetration. There shall be no water, water condensate, moisture penetration, or absorption into any radome wall, laminates, composites, elements, or supplements of the radome.

3.2.1.2.5 Exterior Surface.

3.2.1.2.5.1 Hydrophobic Surface. The exterior surface of the radome shall be hydrophobic (non-water filming).

3.2.1.2.5.2 Exterior Deterioration. The exterior surface of the radome shall not crack, craze, or de-laminate over a 20 year exposure to all environmental conditions as specified in 3.2.2.

3.2.1.2.5.3 Protective Coating. The radome exterior surface shall be white in color in accordance with FED-STD-595 except as otherwise specified by FAA Advisory Circular 70/7460-1 and shall not require recoating for 20 years.

3.2.1.2.6 Ice or Snow Adhesion. The radome exposed surfaces shall exhibit a measurable ice adhesion of less than 10 pounds per square inch shear at a temperature of -5 degrees Celsius (C).

3.2.1.2.7 Flammability and Combustibility. The radome material shall be designed to satisfy the requirements of Federal Aviation Regulations, Part 25.853(b), using the test methods of Part 25, Appendix F, Part 1, as amended in Section 4 herein.

3.2.1.2.8 Effects of Temperature. The radome shall retain its physical and electrical stability throughout the temperature range specified in 3.2.2 for an uncontrolled environment.

3.2.1.2.9 This paragraph is no longer used in this specification.

3.2.1.2.10 Radome Nameplate or Product Markings. The radome shall be marked in accordance with FAA-G-2100 on an inside surface 12 inches above the mounting ring by using non-RF reflective marking.

3.2.1.2.11 Radome Ventilation. The radome shall be ventilated such that an adequate working environment can be maintained without the entry of rain, snow, insects, birds, or dirt.

3.2.1.2.12 Aircraft Obstruction Lights.

3.2.1.2.12.1 Type. The aircraft obstruction light assembly shall meet the requirements of FAA Advisory Circular 150/5345-1.

3.2.1.2.12.2 Installation. The aircraft obstruction light assembly shall be installed in accordance with FAA Advisory Circular 70/7460-1.

3.2.1.2.12.3 Access. The aircraft obstruction light assembly shall provide access to the obstruction lights for maintenance.

3.2.1.2.12.4 Radome. Radome mounted aircraft obstruction lights shall be accessible from inside the radome.

3.2.1.3 Antenna Pedestal Physical Requirements.

3.2.1.3.1 Support. The pedestal shall support the antenna and associated equipment, maintenance equipment, and maintenance personnel.

3.2.1.3.2 Control. The pedestal shall position the antenna in response to the following mode control signals.

a. Off
b. Off Stow/Lock
c. Local maintenance
d. Remote

3.2.1.3.2.1 Off Mode. The pedestal shall execute a command to halt the antenna movement and to turn the driv motors off.

3.2.1.3.2.2 Off Stow/Lock. The pedestal shall execute a command to drive the antenna to a stow/lock position(s), halt the antenna, and turn the drive motors off.

3.2.1.3.2.3 Local Maintenance Mode. The pedestal shall execute a command to allow for local control of all operating functions from the local control box, installed inside the radome in a site location, for pedestal maintenance activities.

3.2.1.3.2.4 Remote Mode. The pedestal shall execute commands for all of its operating functions from the RPG. This shall be the default pedestal operating mode.

3.2.1.3.3 Mechanical Requirements.

3.2.1.3.3.1 Azimuth Rotation. The pedestal shall permit continuous rotation in azimuth in either direction.

3.2.1.3.3.2 Not Used.

3.2.1.3.3.3 Limits, Stops, and Braking. Electrical limits, mechanical stops, and hydraulic shock buffers shall be provided to prevent damage to the antenna and its support structure.

3.2.1.3.3.3.1 Elevation Brake. The pedestal shall provide a fail safe electromechanical brake with an external manual release for the elevation axis.

3.2.1.3.3.4 Structural Height. Any exposed moving pedestal or antenna components shall be mounted at least 10 feet above the local floor level at any antenna elevation angle.

3.2.1.3.3.5 RF Transmission. The TDWR shall allow the direct transmission of RF with the following characteristics between the RDA and the antenna subsystem. These requirements apply with no pressurization.

a.	Frequency	5.60 to 5.65 GHz
b.	Peak Power	2 times nominal
c.	Average Power	2 times nominal
d.	Voltage Standing Wave Ratio (VSWR)	1.25:1 maximum

3.2.1.3.3.6 Pressurization. The waveguides and rotary joints shall withstand pressurization to 15 pounds per square inch (psi).

3.2.1.3.3.7 Waveguide. EIA waveguide flanges shall be utilized.

3.2.1.3.3.8 Alignment. The pedestal shall provide for mechanical alignment as follows:

a.	Axis orthogonality	within 0.02 degrees
b.	Vertical Alignment	within 0.01 degrees
c.	RF to mechanical axis	within 0.05 degrees
d.	Drive train backlash	within 0.005 degrees

3.2.1.3.3.9 Maintenance Requirements.

3.2.1.3.3.9.1 Disable Switch. A Kirk key or equivalent safety system shall be used to disable pedestal operation and disable RF transmitter operation. The lock shall be at the pedestal base and the TDWR equipment room.

3.2.1.3.3.9.2 Communication. The pedestal shall provide communications jacks and head or hand sets at the the antenna azimuth and elevation adjustment positions and at the local control box and at the MDT.

3.2.1.3.3.9.3 Access. The pedestal shall provide access to all components for maintenance and removal, including, but not limited to access doors, stairs, work platforms, and hoists.

3.2.1.3.3.10 Local Control Box. The pedestal shall provide a local control box, installed inside the radome, for maintenance control.

3.2.1.3.3.10.1 Azimuth Manual Controls. The local control box shall provide adjustable manual controls for the azimuth axis to select either a fixed position or rotational rates of 0 to 30 degrees per second.

3.2.1.3.3.10.2 Elevation Manual Controls. The local control box shall provide adjustable manual controls for the elevation axis to select either a fixed position or rotational rates of 0 to 15 degrees per second.

3.2.1.3.3.10.3 Readouts. The local control box shall provide readouts of the commanded and actual azimuth and elevation positions, rotational rates, and stow/lock status.

3.2.1.3.3.10.4 Antenna Stow/Lock Position. The pedestal shall provide a park position to lock the antenna in azimuth and elevation for stowing and maintenance.

3.2.1.3.3.10.5 Antenna Stow/Lock Elevation. When in the stow lock position, the antenna elevation shall be zero degrees.

3.2.1.4 Breakdown. The TDWR antenna group and radome shall permit disassembly without damage for transportation in the original packing containers.

3.2.1.5 Tower Physical Requirements. The TDWR tower shall be constructed in accordance with FAA-C-910 and RS-222.

3.2.1.5.1 Tower Height. The height of the tower shall be selectable in five (5) meter increments from five (5) meters to thirty (30) meters.

3.2.1.5.2 Tower Stability. No attribute of the tower shall prevent any requirements for the antenna group from being met at any tower height, except that RF beam positioning accuracy and repeatability may degrade to 0.05 degrees rms in a steady wind of 25 m/sec.

3.2.1.5.3 Access. The tower shall provide access to the pedestal and antenna for maintenance, including, but not limited to, access doors, stairs, work platforms, hoists.

3.2.1.5.4 Tower Foundation. The tower foundation shall be of the spread footing type design except when local site conditions dictate other suitable types of foundation. The foundation shall be in accordance with the American Concrete Institute (ACI) publication title No. 336.2. The tower foundation design shall adhere to requirments of the soil sampling report.

3.2.1.5.4.1 Concrete Structures/Components. Concrete structures/components shall be designed in accordance with Standard ACI-318. The concrete shall have a maximum slump of 3 inches. Concrete reinforcement shall be deformed reinforcement steel conforming to ASTM A615 or equivalent. Construction of all concrete work shall conform to Part 3, "Construction Requirements", of ACI-318.

3.2.1.5.4.2 Foundation Depth. The concrete tower foundation shall be formed to full depth. The bottom of the tower foundation shall be carried to a minimum depth of 12 inches below the local frost depth (6.3.1), unless other approved methods, such as pile foundations, are used to prevent frost heave of the foundation. Excavation deeper than the required depth shall be brought to the correct level with plain concrete, which shall be allowed to harden before the foundation concrete is placed.

3.2.1.5.4.3 Piers, Pedestals, Etc.. The top four edges of the foundation piers, pedestals, etc, which are above the ground, shall be chamferred a minimum of one inch for the entire width of each face. In addition, all piers and pedestals shall be anchored in a single spread footing to prevent differential settlement, heaving, or uplift associated with high wind loads. If required for stiffness, the pedestals shall be tied together with horizontal reinforced concrete grade beams or shear walls. For sites located in major earthquake areas, the foundation pedestals shall be connected with the horizontal grade beams, or shear walls, or both. The top of the piers or pedestals shall be left a minimum of two (2) inches lower than the finished concrete elevation in order to allow for the proper allignment of the support members.

3.2.1.5.4.3.1 Base Plates. Base plates shall be used under support members.

3.2.1.5.4.3.2 Grout. Shrinkage compensating grout shall be used to grout-in the bases of the columns and other structures supported directly by the concrete foundation.

3.2.1.5.4.4 Concrete Forms. All footings shall be formed for construction. Earth forming shall not be used.

3.2.1.5.5 Tower Tilting. A means shall be provided to compensate for tower tilting.

3.2.1.6 Physical Facility Requirements. The TDWR facility, shelters, materials, and equipment shall be in accordance with FAA-C-1217, FAA-C-2454, FAA-STD-019, FAA-STD-032, NFPA-70, FAA-C-2814, DR-D-6253, FAA Order 3900.19, and OSHA Safety and Health Standards (29 CFR 1910).

3.2.1.6.1 Installation of Government Furnished Engine-Generator. Installation of Government furnished engine generator shall be accomplished in accordance with the manufacturer's instructions. The fuel tank shall be in accordance with FAA-C-2812.

3.2.1.6.2 TDWR System Installation. The TDWR System equipment shall be installed, calibrated, and adjusted in accordance with the applicable equipment instruction books (6.2.17), and approved CSER.

3.2.2 Environmental Conditions.

3.2.2.1 Operating Environment.

3.2.2.1.1 Controlled Environment. The TDWR System equipment located in a controlled environment shall meet all its functional and performance requirements under the environmental conditions specified in FAA-G-2100 for Environment II.

3.2.2.1.2 Uncontrolled Environment. The TDWR System equipment located in an uncontrolled environment shall meet all its functional and performance requirements under the environmental conditions specified in FAA-G-2100 for Environment III.

3.2.2.1.3 Additional Environmental Requirements. In addition to the requirements in 3.2.2.1.2, TDWR System equipment located in an uncontrolled environment shall meet the following additional environmental conditions:

a. Solar radiation - The external TDWR equipment shall withstand the following intensities of ultraviolet, visible, and infrared radiation.

Portion	Wavelength (Microns)	Intensities (wft-2)
Ultraviolet	< 0.38	4 - 7
Visible	0.38-0.78	25 - 50
Infrared	> 0.78	50 - 72

Total Intensity = 104 ± 1 watt per square foot

b. Rainfall. The external TDWR equipment shall operate and sustain no physical damage or degradation in performance when subjected to wind and rain under the following conditions:

(1) Operational - An instantaneous rain rate equivalent to 300 millimeters (mm) per hour with a maximum wind speed of 35 knots.

(2) Non-operational - A one hour average rain rate of 130 mm per hour with an instantaneous rate of 400 mm per hour with a wind speed of 64 knots, a 12 hour average rain rate of 70 mm per hour with a wind speed of 50 knots, and a 24 hour average rain rate of 18 mm per hour with a wind speed of 41 knots.

c. Fungus - TDWR equipment shall be in accordance with FAA-G-2100.

d. Salt fog - TDWR equipment shall operate in a salt-laden atmosphere without degradation of material surfaces or performance.

e. Sand and dust - All performance requirements shall be met when the external TDWR equipment has been subjected to the effects of blowing fine sand and dust particles with wind speeds up to 60 knots and particle concentration of 0.177 grams per cubic meter with particle sizes up to 150 micrometers in diameter.

f. Wind - External TDWR shall meet all performance requirements in winds up to 70 knots in any direction. No damage shall occur in winds up to 120 knots maximum in any direction.

g. Hailstones - The TDWR shall operate in an environment of hailstones up to 1.5 inches in diameter with velocities up to 60 feet per second without permanent radome deformation or damage and without facility damage.

3.2.2.2 Non-Operating Environment. The TDWR shall meet the non-operating environment requirements specified in FAA-G-2100.

3.2.2.3 Induced Environment. The TDWR shall operate without damage in US earthquake seismic zone 4 in accordance with NBSIR 87-3524/ICSSC RP-1.

3.2.3 Not Used.

3.2.4 Materials, Processes, and Parts. TDWR equipment parts shall be selected in accordance with FAA-G-2100.

3.2.4.1 Finish and Color. Painting of all exterior surfaces shall be white in accordance with FED-STD-595, except as otherwise specified by FAA Advisory Circular 70/7460-1 and shal not require refinishing for 20 years.

3.2.4.1.1 Tower Finish. The tower shall be galvanized in accordance with ASTM A-123.

3.2.4.2 Structural Material

3.2.4.2.1 Aluminum Alloy. Components made of aluminum alloy which are load bearing or sustain reaction forces shall be in accordance with SAS-30, ED-33, and WA-20.

3.2.4.2.2 Light Steel. Components made of light gauge steel shall be in accordance with the design specifications of AWS D1.1.

3.2.4.2.3 Welding. Joints of structures of equipment components made of steel and connected by the electric or gas arc welding processes shall be in accordance with the AWS D1.1.

3.2.4.3 Dissimilar Materials. Dissimilar materials (6.2.15) that are electrolytically incompatible with the tendency toward galvanic corrosion, as defined in MIL-STD-889, shall not be placed permanently in contact with each other unless they are suitably protected against galvanic action by suitable quiescent materials.

3.2.4.4 General Design Requirements.

3.2.4.4.1 Design And Construction. The TDWR Radar Equipment, archive recorder, and special test equipment shall be designed and constructed in accordance with FAA-G-2100.

3.2.4.4.1.1 Commercial Available Equipment. The use of commercially available equipment to perform the functions listed below is acceptable provided that the following requirements are satisfied.

3.2.4.4.1.1.1 Government Approval. A commercial device may be used for these listed functions provided prior Government approval is granted.

a. Computers

b. Displays

c. Recorders

d. Heating, ventilation, and air conditioning

e. Environmental control equipment

3.2.4.4.1.1.2 Request for Government Approval. The request for Government approval for use of commercially available equipment in a listed function shall delineate how the following requirements will be met:

a. The proposed commercially available device has published technical descriptions and operational environmental characteristics.

b. The reliability and maintainability program requirements are not derogated.

c. Documentation requirements as specified in FAA-D-2494 for instruction books, software, hardware, and data for spare parts peculiar items will be satisfied.

d. Identify the impact on general requirements that may need to be relaxed in this specification and FAA-G-2100.

e. Identify a second source for the proposed commercial equipment or an alternate source for equivalent equipment.

3.2.4.4.2 Modular Construction (6.2.34). The TDWR shall be modular to the extent that failed components are easily replaceable modules with modularization as defined in MIL-STD-280.

3.2.4.4.3 Microprocessor Standardization. Microprocessors used in the design shall be selected from a single design series.

3.2.4.4.4 Microcontrollers Standardization. Microcontrollers used in the design shall be selected from a single design series compatible with the selected microprocessor series.

3.2.4.4.5 Solid State Design. All active electronic devices, except the transmitter klystron, shall be semiconductor devices in accordance with FAA-G-2100.

3.2.4.4.6 Circuit Design. The circuitry throughout all components of the TDWR shall incorporate microprocessor and digital techniques to the maximum extent practical.

3.2.4.4.7 Nonredundant Operation. When the TDWR has been provided redundancy to meet the requirements of this specification, the TDWR shall perform its function with the redundant components removed.

3.2.4.4.7.1 Dummy Load. The TDWR shall provide a dummy load which can be manually switched into service using not more than two actions. Where redundancy is provided, the standby channel shall automatically operate with a dummy load.

3.2.4.4.8 Accessibility. Accessibility to racks and LRUs shall be in accordance with FAA-G-2100.

3.2.4.4.9 Useful Life. The TDWR shall operate continuously and have a useful life of a minimum of 20 years.

3.2.4.4.10 Electrical Power.

3.2.4.4.10.1 Primary Power Requirements. The TDWR System shall operate from a commercial primary power source of three phase, four wire, AC in accordance with FAA-G-2100.

3.2.4.4.10.2 Design Center Voltage. The design center voltages shall be 208 VAC, phase-to-phase, and 120 VAC single phase at a frequency of 60 hertz (Hz). The operating range shall be at least 102V to 138V, 177V to 239V, and 57Hz to 63Hz.

3.2.4.4.10.3 Power Loss.

3.2.4.4.10.3.1 Power Loss of 3 Minutes Or Less. The TDWR shall maintain all data and shall resume operation as described below following restoration of power if primary power is lost for 3 minutes or less.

Power Loss Period	Recovery Time
0 to 0.5 minutes	less than 30 seconds
0.5 to 3.0 minutes	equal to power loss period

3.2.4.4.10.3.2 Power Loss of Greater Than 3 Minutes. The TDWR System shall restore itself to full operational capability within 15 minutes after restoration of the facility power sources if the power loss is greater than 3 minutes.

3.2.4.4.10.3.3 Backup Power. The TDWR shall automatically switch electrical power to the engine-generator within 15 seconds of primary power outage.

3.2.4.4.10.3.4 Engine-Generator Run Time. TDWR shall interface with the GFE engine-generator, FAA-E-2204. The engine-generator shall provide backup power for 72 hours plus 50 percent.

3.2.4.4.10.3.5 Maximum Engine-Generator Power. The TDWR system power consumption shall be less than 100 kW with any deicing load exempted.

3.2.4.4.10.4 Maximum Power Consumption. The TDWR system power consumption shall be less than 125 kW including any deicing load.

3.2.4.4.10.5 Voltage Regulators. External voltage regulating transformers shall not be used.

3.2.4.4.11 Non-propagation of Failures. An LRU failure shall not cause damage to any other LRU.

3.2.4.4.12 Adjustment. The TDWR shall provide automatic adjustment of essential radar parameters to within allocated tolerances.

3.2.4.5 Structural Loading. The application of structural loading, including the wind loading criteria, shall be in accordance with ANSI A 58.1.

3.2.5 Electromagnetic Interference. The TDWR System shall operate in an electromagnetic interference environment in accordance with FAA-STD-020 and MIL-STD-461.

3.2.5.1 Electromagnetic Compatibility, Electromagnetic Interference, and Radio Frequency Interference. The TDWR System shall comply with the following requirements as Class A3 Equipment (fixed, ground based) in accordance with MIL-STD-461:

3.2.5.1.1 Emissions (Conducted). The emissions (conducted) requirements are as follows:

	Applicable Specification	Range of Requirements
a. AC Power (50/60 Hz)	CE03 CE07	15 KHz - 50 MHz ± 50% of nominal rms voltage
b. DC Power and Control lines	CE03 CE07	15 KHz - 50 MHz + 50%, -150% of nominal voltage
c. Antenna Terminals		
(1) Receivers	CE06	(NB) 34 dB uV (BB) 40 dB uV/MHz
(2) Transmitters (Key up)	CE06	(NB) 34 dB uV (BB) 40 dB uV/MHz
(3) Transmitters (Key Down)	CE06	80 dB down from f_o

Where "NB" is narrow band and "BB" is broad band.

3.2.5.1.2 Emissions (Radiated). The emissions (radiated) requirements are as follows:

	Applicable Specification	Range of Requirements
a. Magnetic Field	RE01	30 Hz - 50 kHz
b. Electrical Field	RE02 RE02 RE03	14 kHz - 10 GHz (NB) 14 kHz - 1 GHz (BB) -80 dB

3.2.5.1.3 Susceptibility (Conducted). The susceptibility (conducted) requirements are as follows:

	Applicable Specification	Range of Requirements
a. All Power Lines	CS01 CS02 CS06	30 Hz - 50 kHz 50 Hz - 400 MHz Spikes & Transient

b. Antenna Terminals	CS03	Intermodulation, 2 - signal
	CS04	Residual of undesired signal
	CS05	Cross Modulation
	CS07	Squelch (if any) Test 1, 90dB/v/MHz Test 2, 2-Signal Method

3.2.5.1.4 Susceptibility (Radiated). The susceptibility (radiated) requirements are as follows:

	Applicable Specification	Range of Requirements
a. Magnetic Field	RS01	30 Hz - 50 kHz
b. (1) Spikes	RS02	E2 = 400 V; T2≤5 usec
(2) Power Frequency	RS02	20 amps @ Power Frequency
c. Electric Field	RS03	14 kHz - 10 GHz (see below)

Frequency Range	E-Field (Volts/meter)
14 kHz to 2 MHz	1
2 to 30 MHz	10
30 to 2000 MHz	5
2 to 10 GHz	5

3.2.5.1.5 Cross-Talk, Shielding, and Isolation. The arrangement of parts and wiring and the design of the TDWR equipment shall be such that cross-talk and unnecessary coupling between circuits do not result in the degrading of specified performance characteristics.

3.2.5.1.5.1 Shielding. Shielding or other means of isolation, or both, shall be provided to prevent the degrading of performance in signal levels, waveforms, timing, tuning, or operating conditions when access doors are open, chassis are withdrawn, or a printed circuit board extender is in use.

3.2.5.1.5.2 Wire Position. Wires and cables shall be installed and routed such that performance of the TDWR System equipment is not degraded.

3.2.6 Workmanship. Workmanship shall be in accordance with FAA-G-2100.

3.2.7 Interchangeability. All TDWR equipment furnished shall be interchangeable in accordance with FAA-G-2100.

3.2.8 Safety. The TDWR shall be designed in accordance with FAA Order 3900.19, OSHA Safety and Health Standards (29 CFR 1910), and FAA-G-2100.

3.2.8.1 Not Used.

3.2.8.2 Work Platforms. All work platforms over 24 inches above the local ground elevation shall have stairs for access to the platforms and a catwalk around the entire enclosure for maintenance access.

3.2.8.3 Weight Limitations. If weight limitations of the fifth percentile male size/strength tables of MIL-STD-1472 are exceeded by LRUs, test equipment, portable terminals, or tools, then a hoisting or wheeled device shall be provided. This requirement shall not apply to items whose size or weight precludes use of human-powered or fractional horsepower motor devices (e.g., antenna dish, tower, engine-generator).

3.2.8.3.1 Weight/Center of Gravity. Weight/center of gravity caution placards shall be placed on the equipment to be moved for maintenance when weights exceed 30 pounds maximum.

3.2.8.3.2 Lifting Attachments. All equipment that must be handled with lifting devices shall be provided with lifting attachments, e.g., hooks, rings, eyes.

3.2.8.4 Microwave Radiation Exposure. The TDWR System shall be in accordance with FAA Order 3910.3.

3.2.8.5 Safety Program. The TDWR System safety program shall be in accordance with MIL-STD-882.

3.2.9 Human Performance/Human Engineering. Human engineering shall be in accordance with FAA-G-2100 and MIL-STD-1472.

3.2.10 Not Used.

3.2.11 Not Used.

3.2.12 Software Development.

3.2.12.1 Software Requirements. All software and firmware shall be developed in accordance with OD-STD-2167.

3.2.12.1.1 Commercially Available Software. The use of commercially available software may be acceptable provided prior Government approval is granted. The request for Government approval for use of commercially available software shall delineate how the following requirements are met:

a. The proposed commercially available software has published technical descriptions showing suitability of use.

b. The reliability and maintainability program requirements are not derogated.

c. Documentation requirements, as specified in the contract, are acceptably satisfied.

d. Licensing, use, and limits of use do not degrade specified performance and are acceptable to the Government.

e. All modifications are accomplished in accordance with DOD-STD-2167 and as specified herein.

3.2.12.2 Programming Language(s). All software developed for the TDWR System shall be written in a single higher order programming language (HOL) except for those cases where it is shown that processing efficiency requirements dictate the use of a lower order language. No lower order language shall be used or coded without advance Government approval in each instance.

3.2.12.2.1 Algorithms. All meteorological algorithms shall be coded in a higher order language.

3.2.12.2.2 Government Approval. The programming language implemented for all software shall be Government approved.

3.2.12.3 Operability. The software shall detect, store, and report software errors and recover from abnormal conditions.

3.2.12.3.1 Protection from Inappropriate Commands. The software shall accept only appropriate commands and respond with plain language messages to inappropriate commands. In no case shall any casual keyboard entry or lack of entry cause the system to change mode.

3.2.12.4 Logical and Physical Independence. The logical data structures shall be independent from the physical data structures of the software.

3.2.12.5 Data Retrieval. The software shall provide a common approach to storing and retrieving data.

3.2.12.6 Fault Recovery. The software shall assure that the system is initialized to a correct, well defined state upon recovery from a fault, and that all processing interrupted by a fault is properly continued after recovery.

3.2.12.7 Load Message. All software shall generate a load message to the RMS when loaded. The load message shall include the software name or function, the software release and revision level, and the site identification.

3.2.12.8 System Software Revisions. The TDWR System shall provide for system software revisions on transportable disk or tape.

3.3 Processing Resources.

3.3.1 System Controller, Data Processing, and Signal Processing Resources.

3.3.1.1 Computer Hardware Requirements.

3.3.1.1.1 Automatic Data Processing Security. The TDWR System and information shall be protected in accordance with FAA Order 1600.54.

3.3.1.1.2 Loading. Any hardware module, whether custom or commercial, which accomplishes its intended task through the execution of software and/or firmware instructions shall not be loaded to more than fifty (50) percent of capacity when averaged over any continuous fifteen (15) second period.

3.3.1.1.3 Not Used.

3.3.1.1.4 Auxiliary Storage Requirement. Each type of memory (ROM, RAM, NVRAM, PROM, EPROM, EEPROM) for each processor in the TDWR system shall contain excess utilization capacity of at least 50%.

3.3.1.2 Not Used.

3.3.1.3 Not Used.

3.3.1.4 Computer Processor Utilization.

3.3.1.4.1 Computer Performance Monitoring (CPM). The CPM shall monitor the following computer utilization parameters and report via the RMS:

a. Memory

b. CPU

c. Mass Storage

d. I/O Channel

e. Communication Lines

3.3.2 Off-Line Storage of System Software. The system software shall be recovered from a secondary storage device in the event that a system restart or cold system start-up is necessary and software errors are detected.

3.4 Quality Factors.

3.4.1 Reliability. The TDWR system reliability program shall be in accordance with MIL-STD-785 and the following.

3.4.1.1 Applicability. For the purpose of the reliability program, the complete TDWR system shall be included.

3.4.1.2 Not Used.

3.4.1.3 Hardware Reliability. The TDWR system hardware reliability requirements shall be specified in terms of Full Mission Capability (6.2.19), Mean Time Between Critical Failure (MTBCF) (6.2.30) (6.2.13), and Mean Time Between Failure (MTBF) (6.2.31) (6.2.18).

3.4.1.3.1 Mean Time Between Critical Failure. The TDWR system shall have a MTBCF of 1500 hours or greater.

3.4.1.3.2 Mean Time Between Failure. The TDWR system shall have a MTBF as follows:

	MTBF (Hours)
TDWR System	550
Base Data Recorder	5000
Portable Base Data and Product Display	5000
Situation Display	5000
Ribbon Display	9000

3.4.1.4 Software Reliability. The TDWR system software reliability, defined in terms of the number of unresolved software errors (6.2.45) at the completion of software qualification testing, shall be:

Software Error Category	Maximum Number of Unresolved Errors
1	Zero
2	1/70k machine instruction words (6.2.26)
3	1/35k machine instruction words

3.4.2 Maintainability. The TDWR system maintainability program shall be in accordance with MIL-STD-470 and the following requirements.

3.4.2.1 Applicability. For the purpose of the maintainability program, the complete TDWR system shall be included.

3.4.2.2 Allocation. The TDWR system maintainability program shall assure the following Mean Time To Repair (MTTR) (6.2.32), Mean Bench Repair (MBR) (6.2.29), and Maximum Corrective Maintenance Time (MXCMT) (6.2.28) requirements are achieved.

3.4.2.2.1 Mean Time To Repair. The TDWR system shall have a MTTR of 0.5 hours or less.

3.4.2.2.2 Mean Bench Repair. The TDWR LRUs shall have a MBR of 1.0 hour or less, with 95 percent of all bench repairs completed in less than 4 labor hour.

3.4.2.2.3 Maximum Corrective Maintenance Time. The TDWR system shall have a MAXCT of 2.0 hours.

3.4.2.3 Flexibility And Expansion.

3.4.2.3.1 Processing Power Expansion. The RPG processing capacity, memory and data and product storage shall be expandable to 3 times its product baseline configuration by field modification. The expanded system shall meet all timing requirements of this specification.

3.4.2.3.2 Provision of Display. The display and RPG functions shall be expandable to 2 times its base line configuration by field modification to support satellite airports and unusual airport configurations. The expandability shall include the ability to tailor and transmit the TDWR products to end-users at more than one airport including the ability to transmit only hazardous weather products for a given airport to that airport.

3.4.2.4 Automatic Fault-Isolation. The TDWR System shall incorporate automatic fault-isolation in the form of BITE/BIT such that 95 percent of all failure occurrences can be isolated to a single faulty LRU, and 100 percent to not more than two (2) LRUs at a 95 percent confidence level.

3.4.2.4.1 Residue Faults. The TDWR System equipment failures not isolated by BITE/BIT shall be isolated to a single LRU by use of front panel test points using test equipment and maintenance procedures.

3.4.2.4.2 Automatic Fault-Isolation False Alarm Rate. The TDWR System automatic fault-isolation false alarm rate shall be equal to, or less than, 2 percent.

3.4.3 Availability (6.2.5). The TDWR shall have an inherent availability (6.2.24) of 0.99967.

3.4.4 Not Used.

3.4.5 Not Used.

3.5 Logistics. Logistics support for the TDWR System shall be in accordance with MIL-STD-1388-1, MIL-STD-1388-2, and FAA Order 1800.58.

3.5.1 Support Concept.

3.5.1.1 Restoration. The TDWR System equipment shall allow expeditious restoration following a failure by replacement of a replaceable LRU.

3.5.1.2 Not Used.

3.5.1.3 Maintenance Concept. The TDWR Maintenance Concept is based on the "Maintenance Concept of the 90's" as defined in FAA Order 6000.30.

3.5.1.3.1 Levels Of Maintenance. The TDWR System shall have two levels of maintenance: (1) site (6.2.44) and (2) depot (6.2.27)

3.5.1.4. Maximum Maintenance. The TDWR System shall require no more than six (6) site visits per year for corrective maintenance of critical failures and no more than ten (10) site visits per year for combined non-critical failure corrective maintenance and preventive maintenance.

3.5.1.4.1 Preventive and Non-critical Failure Corrective Maintenance. No more than four (4) of the non-critical failure corrective maintenance and preventive maintenance site visits shall exceed two (2) hours operational outage per visit at the 90th percentile or six (6) hours at the 99th percentile. The total of all operational outages for non-critical failure corrective maintenance and preventive maintenance shall not exceed eight (8) hours per year at the 90th percentile. Preventive maintenance shall not occur more frequently than once every 91 days and shall require no more than 25 total labor hours per year. The maximum combined total labor hours for both on-site preventive and non-critical failure corrective maintenance shall not exceed 100 hours per year.

3.5.1.4.2 Not Used.

3.5.1.4.3 Ease of Maintenance. The mechanical design of the TDWR System shall assure ease of maintenance of any equipment.

3.5.1.4.4 Software Maintenance. Software performance monitoring and software maintenance operations shall not interrupt normal system operations.

3.5.1.5 Supply Support. The TDWR System provisioning shall be accomplished in accordance with MIL-STD-1388-2 and MIL-STD-1561.

3.5.1.6 Instruction Manuals. Instruction manuals shall be prepared in accordance with FAA-D-2494.

3.5.1.7 Special Test Equipment.

3.5.1.7.1 Portable Base Data and Product Display. The TDWR shall have a portable Base Data and Product Display for use at the RPG. This shall be a color raster display with at least 640 x 480 pixels, each of which can display one of 16 distinct colors, chosen from a palette of at least 4092 possible colors. The displayed information shall be selected from the following choices, as commanded via the product base data and product display terminal:

a. any single base data image, of at least 256 x 256 data points, from a single specified PPI (360 degrees or sector) scan or RHI scan. PPI resolutions of 0.25 km, 1km, or 2km shall be selectable via the portable base data and product display terminal. An RHI scan starting range shall be selectable via the portable base data and product display terminal. RHI scans shall have a resolution of 0.25 km.

b. Any one of the current situation display graphical products.

c. a. and b. (excluding the precitation product).

The base data and graphical product overlay display shall be generated within 30 seconds after the completion of the selected scan, and remain displayed until a new scan is explicitly selected by the operator.

3.5.1.7.2 Base Data Recorder. The TDWR shall have a portable Base Data Recorder for recording and playback of base data and associated timing and control information. The Base Data Recorder shall have the following characteristics:

a. playback of recorded data to result in TDWR product output identical to live data;

b. one hour minimum record/playback time;

c. remote and local control, and status and data transfer, via the base data port;

d. fast forward and rewind;

e. operational and capacity remaining status.

3.5.2 Support Facilities.

3.5.2.1 Hardware Support. All equipment, documentation, and training necessary for the fault isolation, repair, and return of LRUs to an operational state shall be provided. The equipment furnished shall include, but not be limited to, special ATE test adapters and software for test equipment at the National Airways Engineering Field Support Sector, APM-150, FAA Aeronautical Center.

3.5.2.2 Program Support Facility (PSF). The TDWR PSF shall be located in a Government furnished building assigned to the National Airways Engineering Field Support Sector, APM-150, FAA Aeronautical Center. The TDWR PSF shall include all of the equipment, supporting software and firmware, and documentation required for the development, maintenance, testing, analysis, and debugging of all TDWR functional programs.

3.5.2.2.1 Support Computers.

3.5.2.2.1.1 Functions supported. The TDWR PSF support computers shall have a capacity for two basic types of activities:

a. running the TDWR algorithms on recorded base data in a play-back mode, and

b. developing, testing, and executing software for both operational and off-line analysis purposes, including (but not limited to):

   (i) Text editing and printing

   (ii) Program assembly or compilation

   (iii) Program linking or loading

   (iv) Running standard data analysis utilities

   (v) Running functional programs

   (vi) Designing, testing, and debugging

NOTE: The computer hardware used to perform functions (a & b) need not be identical.

3.5.2.2.1.2 Performance. The computers shall have memory, storage, computational, and input/output capacity to perform the following.

3.5.2.2.1.2.1 Base Data Playback. Base data as recorded from a base data recorder shall be played back at a real-time rate (i.e., read and process the recorded data at least as fast as it was processed on the TDWR equipment).

3.5.2.2.1.2.2 Software Development and Test. Source software compilation shall execute at an average rate of at least 60 lines of system HOL per minute, for each of up to six simultaneous users performing software development and testing activities.

3.5.2.2.1.2.3 Simultaneous Operation. Twenty percent degraded timeliness for each activity shall be allowed when the two types of activities (3.5.2.2.1.1) are performed simultaneously.

3.5.2.2.1.3 System Software Generation. Operational software shall be compiled on the PSF.

3.5.2.2.2 Support Computer Peripherals. The PSF computer system shall include all those peripheral devices, communications lines, and corresponding control software necessary for the system users to perform the required data playback and software development activities. Specific requirements are detailed below.

3.5.2.2.2.1 Interactive Video Displays. The PSF shall include at least six interactive video display terminals for the control and execution of PSF functions and applications.

3.5.2.2.2.2 Weather Data and Product Displays. The PSF shall include at least one color display device to display either base data or graphical product images or both, with formats and controls compatible with those in the situation display and maintenance base product displays. The PSF shall also display alphanumeric data.

3.5.2.2.2.3 Magnetic Disk Storage. The PSF shall include read/write mass storage, in the form of magnetic disk(s), with the capacity to store all PSF applications and operating system software and at least 24 hours of both base and archive product data.

3.5.2.2.2.4 Alphanumeric Hard Copy. The PSF shall include at least one alphanumeric hardcopy unit, with a minimum printing rate of 600 lines (132 characters per line) per minute.

3.5.2.2.2.5 Graphics Hard Copy. The PSF shall include at least one monochrome graphics hardcopy unit, with a minimum resolution of 200 dots (or lines) per inch.

3.5.2.2.2.6 Magnetic Tape Drives. The PSF shall include at least two 9-track magnetic tape units, with selectable read and write densities including both 1600 and 6250 bits per inch, at a minimum.

3.5.2.2.2.7 Base Data Playback. The PSF shall include a base data playback unit compatible with the base data recorder unit.

3.5.2.2.2.8 Archive Product Playback. The PSF shall include an archive product data playback unit compatible with the archive product data recorder. The archive data playback display shall include the following:

a. Time tags displayed with retrieved archived data,

b. Select recall of product data by type and time tag.

Note: The magnetic tape drive unit may be used to satisfy either or both of the base data and archive product playback requirements, if the media, data formats, and control software modules are compatible.

3.5.2.2.3 Firmware Support Equipment. Support equipment shall be provided to develop maintain, test, analyze and debug all the TDWR functional programs located in firmware.

3.5.2.2.4 Expandability. The PSF shall include the CPU, input/output channel, and memory resources required for the expansion of the PSF to twice the specified number of each class of peripheral device.

3.5.2.2.5 Not Used.

3.5.2.2.6 System Utilities. System utilities used for diagnostics and performance monitoring shall be identical to those used in an operational TDWR.

3.5.2.2.7 Not Used.

3.5.2.2.8 Portable Display. The TDWR PSF equipment shall provide a portable archived data playback and display, including:

a. Color display with resolution the same as the situation display, as a minimum,

b. Display product status, configuration, and background maps in the same format as the situation display,

c. Display all archived information when selected.

3.5.3 Not Used.

3.5.4 **Personnel.**

3.5.4.1 Maintenance Personnel. The TDWR System shall be maintainable by personnel in accordance with FAA Order 6000.27.

3.5.5 **Training.** Training will be in accordance with FAA-STD-028.

3.6 **Precedence.** In the event of a conflict between requirements, the following order of precedence (highest = a) shall apply:

a. This specification and its appendices

b. FAA Specifications and Standards

c. FAA Orders

d. FAA Plans

e. Military Standards

f. Federal Standards

g. Other documents

4. QUALIFICATION REQUIREMENTS.

4.1 **General**. A quality control system shall be established in accordance with FAA-STD-016 and a software quality control program in accordance with FAA-STD-018. Reviews and audits shall be held in accordance with MIL-STD-1521.

4.1.1 **Philosophy of Testing**. In general, testing of specification compliance shall be accomplished at the lowest level feasible (i.e. module, subsystem, system). The contractor shall accomplish the following testing to demonstrate compliance with engineering specifications.

a. In-Plant Design Qualification Test (DQT) and Evaluation (In-Plant DQT).

b. On-site Design Qualification Test and Evaluation and Technical Field Test and Evaluation (On-Site DQT and TFT&E).

c. In-plant Production Acceptance Test and Evaluation (PAT&E) (In-Plant PAT&E) on all systems and Type Testing on selected serial numbers per FAA-G-2100.

d. Key Site/Subsequent Installation, Checkout, and Acceptance Testing.

4.1.2 **Test Location**.

a. In-Plant DQT. In-Plant DQT shall be conducted on components, subsystems, and the entire system during development at the contractor's test facility.

b. DQT and TFT&E. On-Site DQT and TFT&E will be conducted at a Government designated test facility.

c. PAT&E and Type Testing. Verification of subsystems and systems shall be conducted in the factory prior to shipment to the site.

d. Key-Site/Subsequent Installation, Checkout, and Acceptance Testing. Installation, Checkout, and Acceptance Testing shall be conducted at a Government designated key-site (first operational site) and subsequent sites.

4.1.3 Responsibility for Test. The Contractor shall develop and conduct the necessary analysis, tests, demonstrations, and inspections to ensure compliance to all requirements of this specification.

4.1.4 Qualification Methods.

4.1.4.1 Verification Methods. This subsection describes the methods to be used by the contractor in verifying each Section 3 requirement.

4.1.4.1.1 Inspection.

4.1.4.1.1.1 Hardware. Inspection of hardware shall include verifying physical characteristics to determine compliance with requirements without the use of special laboratory equipment, procedures, items, or services. Inspection shall verify construction features, document and drawing compliance, workmanship and physical condition.

4.1.4.1.1.2 Software. Software inspection shall be a non-destructive examination that includes review of software documentation, requirements, and coding standards, as well as verification of the implementation of required algorithms. Software inspection shall not incorporate use of laboratory equipment or procedures to determine compliance with requirements.

4.1.4.1.2 Test.

4.1.4.1.2.1 Hardware. Hardware testing shall measure hardware performance during or after the controlled application of functional and/or environmental stimuli. Measurements require the use of laboratory equipment, procedures, items, and/or services.

4.1.4.1.2.2 Software. Software testing shall employ technical means, including evaluation of functional operation by use of special equipment or instrumentation, simulation techniques, and the application of established principles and procedures, to determine compliance of the system with requirements. Data derived from software testing shall be reduced for analysis of software/system performance under the test specified.

4.1.4.1.3 Demonstration.

4.1.4.1.3.1 Hardware. Hardware demonstration shall determine the qualitative characteristics of end-item or component properties by observation. Demonstration shall not require special test equipment or instruction to verify characteristics such as operational performance, human engineering features, service, access features, and transportability.

4.1.4.1.3.2 Software. Software demonstration shall determine compliance with requirements (e.g., the proper response at a site as a result of a specified interrogation or command to be processed by the program) through observation of functional operation. Demonstration shall be used primarily for activities where data gathering is not appropriate, such as CRT display verification.

4.1.4.1.4 Analysis.

4.1.4.1.4.1 Hardware. Hardware analysis shall encompass any or all of the following:

a. Engineering Analysis. Usually an engineering design function involving study, calculation, or modeling of the known or potential failure modes, and reaction or interactions of the specified parts, materials, and the design configuration with the known function, performance and/or probable effects of the operational environments. This analysis is normally used to verify margin when it is not desirable to test to failure.

b. Similarity Analysis. A method applied to end-items or components that are identical in design and manufacturing processes to end-items or components that have been previously qualified to equivalent or more stringent requirements.

c. Validation of Records Analysis. A method of verification wherein manufacturing records are used to verify compliance of concealed construction features or processes of manufacturing (e.g., vendor items).

4.1.4.1.4.2 Software. Software analysis shall encompass the processing of accumulated results and conclusions to provide proof that the verification of requirements has been accomplished. The analytical results may be composed of interpretation of existing information or derived from lower level tests, demonstrations, analyses, or examinations.

4.1.5 System Tests.

4.1.5.1 First System Testing. A complete series of Design Test and Evaluation (DT&E) tests shall be performed beginning as a minimum with Contractor LRU level testing, Contractor Preliminary Tests (CPT) and progressing to formal testing. Formal testing shall include Design Qualification Test (4.2.1), Type Test (4.2.2), FCC Type Acceptance and Registration Procedures (4.2.5), Production Acceptance Test and Evaluation (PAT&E)(4.2.7), Reliability Demonstration (4.2.3), Maintainability Demonstration (4.2.4), and Key Site Installation, Checkout, and Acceptance Testing (4.2.8). Each test shall be started and successfully completed on the same equipment.

4.1.5.1.1 On-Site Design Qualification Test/Technical Field Tests and Evaluation (TFT&E). Qualification testing shall be continued on-site to verify external interfaces and preliminary installation, checkout, and acceptance test procedure verification. At the completion of the on-site qualification tests, a Government conducted, contractor performed TFT&E shall be performed to provide a preliminary assessment of TDWR operational effectiveness and suitability under field conditions.

4.1.5.2 Production Testing. System level production tests shall be conducted to verify that the system meets the performance requirements prior to delivery. This testing shall include the PAT&E (4.2.7) and Type Tests (4.2.2) in accordance with FAA-G-2100.

4.1.5.3 Key-Site Installation, Checkout, and Acceptance Testing. The system shall be installed at an operational location designated by the FAA. Installation, checkout, and acceptance test procedures shall be demonstrated and validated at this Key Site and used for all subsequent site installations. Acceptance testing shall include the system level tests in the PATumn of the VRTM.

4.2 **Formal Tests**. Formal TDWR testing shall be conducted as listed below. Prior to any formal testing, Contractor Preliminary Tests in accordance with FAA-G-2100 shall be performed to ensure that test items are ready for Government witnessed tests.

4.2.1 **Design Qualification Tests**. All requirements specified to be verified by test in the VRTM DT&E column, shall be verified during qualification testing to verify the adequacy of the design to meet the specification. The Design Qualification Tests shall be in acccordance with FAA-G-2100 and the tests in the following paragraphs.

4.2.1.1 System Alignment. The TDWR system shall be completely aligned utilizing only the procedures and test equipment cited in the instruction manuals. Verification and validation testing shall be performed to determine the adequacy of techniques, technical manuals, and test equipment.

4.2.1.2 Antenna Assembly and Alignment. The antenna shall be assembled and aligned in accordance with procedures contained in the instruction manuals. Assembly and alignment shall be performed utilizing only those alignment fixtures and tools provided as part of the TDWR equipment. Antenna testing shall be performed as defined in 4.2.1.5 to verify the antenna can be field installed with resultant performance in accordance with specified requirements.

4.2.1.2.1 Antenna Group Tests. The following tests shall be performed with all components of the antenna group (6.2.3) installed. Results of these tests shall meet the derived requirements of the TDWR scan strategy, Engineering Report DOT/FAA/PM-87-22.

4.2.1.2.1.1 Locked Rotor Response. The locked rotor response shall be measured to determine the presence of undesired response in the frequency domain.

4.2.1.2.1.2 Position Loop Step Response. The step response shall be measured to determine the stiffness between the antenna line of sight and the shaft encoder.

4.2.1.2.1.3 Acceleration Constant. If two stages of integration are used in the servo, the acceleration constant shall be measured.

4.2.1.2.1.4 Position Loop Servo Bandwidth. The servo loop bandwidth shall be measured.

4.2.1.2.2 Antenna Integrity Test. An antenna group which has met all RF, structural, and dynamic tests shall be disassembled and staged for shipment. The antenna shall be reassembled, and all RF, structural, and dynamic tests shall be repeated to demonstrate that the cycle from in-plant test to final installation does not degrade the antenna performance and characteristics. The results of these tests shall meet the derived pedestal requirements based on those imposed by the scan strategy requirements, Engineering Report DOT/FAA/PM-87-22.

4.2.1.3 Antenna Manufacturing Contour Tolerance Test. The contour tolerance qualification test shall be performed in accordance with EIA Standard RS-411 on one antenna, under static load, to determine its compliance with operational maximum dynamic loads.

4.2.1.4 Antenna Test Requirements. The antenna test site shall be able to make antenna gain measurements to an accuracy of ±1dB. Continuous pattern recording equipment shall be used to record the pattern data. A digital data acquisition system with both a "quick look" and a comprehensive data analysis facility may be offered as a substitute for the continuous pattern recorder.

4.2.1.5 Antenna Pattern Tests. The following tests shall be performed at 5.60, 5.625, and 5.65 GHz as a minimum. The antenna subsystem may be tested independently from the rest of the system. Azimuth and elevation radiation patterns shall be taken in accordance with 4.2.1.4. The antenna shall be mounted on a test pedestal to rotate it over the azimuth angles and about the boresight axis required for the measurement.

4.2.1.5.1 Pattern Tests. Sufficient azimuth and elevation pattern cuts shall be taken to verify that the beam shape and sidelobe level specifications are met and to provide the data required for subsequent system performance analysis and interpretation of weather and clutter observations. As a minimum the following patterns shall be taken at each of the frequencies defined in 4.2.1.5.

a. Azimuth pattern at the peak of the beam in elevation covering 360 degrees.

b. Expanded pattern centered on the peak of the beam in elevation covering ±10 degrees.

c. Elevation pattern centered on beam peak covering ±90 degrees.

d. Expanded elevation pattern centered on beam peak covering ±10 degrees.

e. 180 degree pattern in the plane defined by each antenna feed support and the boresight axis. Total number of patterns equals the number of feed supports. For this test, measurement at 5.625 GHz, only, is acceptable.

f. Repeat a. through d. above measuring the cross polarized component.

4.2.1.5.2 Antenna Gain Measurement. The antenna gain shall be measured at each of the frequencies specified in 4.2.1.5. The measurement accuracy shall be ±0.5 dB or better. A calibrated gain reference level shall be noted on each of the patterns obtained in 4.2.1.5.1. The antenna gain shall be referenced to the waveguide flange on the antenna side of the elevation rotating joint.

4.2.1.5.3 Pattern Stability (Squint). The beam squint for each 10 degree pattern shall be measured. The beam squint is defined as the angular difference between the mechanical boresight reference and the center of the beam, as determined by the midpoint between the 3 dB points of the pattern. Squint shall be determined for three frequencies in the azimuth (principal) and elevation (zenith) planes.

4.2.1.5.4 Beam Shape. The -3, -10, -15, and -20 dB beamwidths shall be noted on the 10 degree patterns.

4.2.1.5.5 Transmission Characteristics. The VSWR and line losses of all components on the antenna and pedestal shall be determined individually and in aggregate.

4.2.1.6 Radome Materials Tests. Specific radome materials tests shall be performed for flammability, combustibility, and hydrophobicity.

4.2.1.6.1 Radome Combustibility Test. The radome material shall be tested to the requirements of Federal Aviation Regulations, Part 25.853(b), using the test methods of Part 25, Appendix F, Part 1.

4.2.1.6.2 Radome Flammability Test. The radome material shall be tested to the requirements of Federal Aviation Regulations, Part 25.853(b), using the test methods of Part 25, Appendix F, Part 1.

4.2.1.6.3 Radome Hydrophobic Surface Test. The radome material shall be tested for its hydrophobic surface properties. The maximum surface free energy shall be 20 ergs/cm^2. Hydrophobicity measurements shall include the measurement of water contact angles as measured using a Kaness, Inc. Model D-1060 or equivalent Contact Angle Viewer.

4.2.1.6.4 Radome Water Absorption Test. Radome wall samples (24 x 36 inches) shall be tested for each and all o its subcomponents by total immersion of sample(s) of wall subcomponents under one inch of water with sample edges unsealed. The sample weight, after 24 hours of total immersion, shall not increase more than 0.5 percent due to absorbed water.

4.2.1.6.5 Radome Weathering Test. Advanced weathering tests that conform to ASTM G-53 shall be performed on radome materials.

4.2.1.6.6 This paragraph is no longer used in this specification.

4.2.1.6.6.1 This paragraph is no longer used in this specification.

4.2.1.6.7 This paragraph is no longer used in this specification.

4.2.1.6.8 Radome Computer Simulation. The contractor shall verify the radome's impact on antenna group performance and sensitivity by using computer modeling at the TDWR frequencies.

4.2.1.7 Clutter Suppression Demonstration. Demonstration of the ground clutter suppression capability shall be accomplished by processing of simulated digitized samples from individual range gates and by the tests described below.

4.2.1.7.1 Computer Simulation Studies. For purposes of simulation, the system front end noise may be ignored, but quantization noise and arithmetic precision effects shall be considered. The clutter suppression capability simulation studies will use clutter models A and B (6.2.21), and simulated weather data with various mean velocities and spectrum widths.

4.2.1.7.2 Instability Residue Measurement. The integrated instability residue (IR) ratio shall be measured at the highest and lowest PRF for Doppler measurements using (1) the Stability Test Input Signal (3.1.4.1.5.1) and (2) a stable point target with the antenna in a fixed position. The waveform(s) used for the integrated IR test shall be those utilized at the elevation angles where clutter suppression is selected. Spectra shall be taken in the form of Discrete Fourier Transforms (DFT's) at 16 equally spaced points across the pulse at the input to the A/D's after receiver narrow banding. The spectra at each range shall be composed of the required number of DFT's such that each spectral line has a variance of less than 4 dB.

Let $P_i(n)$ = the sum of the power in all the non-zero frequency lines at the nth measurement point on the pulse envelope, and

$P_0(n)$ = the power of the zero frequency line of the nth measurement point on the pulse envelope.

Then the integrated stability residue power ratio is

$$IR = \frac{\sum_{n=1}^{16} P_i(n)}{\sum_{n=1}^{16} P_0(n)}$$

and shall be less than -55 dB.

The spectral resolution of this test shall be no coarser than 10 Hz. The 1st and the 16th measurement shall be 40 dB below the peak value of the pulse. Spectral floor noise due to quantization need not be counted. A/D's having 12 or more bits shall be used for this measurement. In this test, at least one $P_0(n)$ shall be within 3 dB of the A/D saturation level.

4.2.1.7.3 Clutter Suppression on Point Target. The signal return from a fixed discrete scatterer (e.g., a corner reflector) in the antenna far field (using the normal radome and at the PRF to be used at low elevation angles) shall be used to provide a clutter model B signal. The antenna shall be rotating in azimuth at the scan rate used for microburst outflow detection in the off-airport hazardous weather mode scan strategy, Engineering Report DOT/FAA/PM-87-22. The suppression of this signal (characterized in accordance with paragraph 6.2.21) shall be no worse than that shown for clutter model B in Table I with 5 dB degradation allowed for range testing imperfections.

4.2.1.8 Electromagnetic Compatibility (EMC), Electromagnetic Interference (EMI), and Radio Frequency Interference (RFI). The TDWR system EMI design requirements shall be tested to in accordance with MIL-STD-462.

4.2.1.9 Remote Monitoring Subsystem. A demonstration of the operation, ease of calibration, and effectiveness of the RMS shall be performed. This shall include off-line diagnostics, field adjustable parameter selection, and the suitability of RMS test equipment for use during corrective maintenance.

4.2.1.10 Algorithm Implementation Test. Software testing shall be employed to determine that the software used to implement the Government furnished meteorological algorithms is correct. Government furnished base data (GFI) shall be used as test data, and the resulting algorithm outputs compared with corresponding Government supplied correct outputs. The results of this comparison test shall be analyzed to determine the performance of the software system on the test data cases.

4.2.1.11 Algorithm Implementation Demonstration. Software demonstration shall determine that the Government furnished algorithms have been properly implemented. The software subsystem used to implement the algorithms shall be demonstrated using Government supplied base data (different from that used for testing). Results of the demonstration data processing will then be provided to the Government for comparison to correct outputs. Any failure shall require a rerun of this demonstration after the problem is corrected.

4.2.1.12 PRF Selection Demonstration. Government furnished base data shall be used to demonstrate that PRF selection is in accordance with Engineering Report DOT/FAA/PM-87-25. Results of the demonstration data processing shall be provided to the Government to determine if the selection technique complies with the specified criterion. Any failure shall require a rerun of this demonstration after the problem is corrected.

4.2.1.13 Signal Processing Simulation Test. The signal processor functions shall be tested, in the context of the complete system, by the injection of simulated data. This data shall be generated in accordance with the Government supplied weather event models and specific data cases described in Engineering Report DOT/FAA/PM-87-37. Simulated signal processor inputs shall be generated from the idealized weather models and case data, to mimic the effects of range and velocity aliasing, SNR, and parameter estimation errors. This simulated data shall then be injected into the signal processor or validated emulation of the signal processor. All signal processor and RDA functions shall be invoked on the simulated input data, and the resulting base data sent to the RPG for algorithm processing. Verification of the signal processor functions shall be accomplished by comparison of the base data and the algorithm outputs to the weather models, and data corresponding to correct weather processing algorithms results. Each weather event model shall be simulated at a representative set of the PRF values the contractor plans to use for wind shear detection. Base data accuracy as determined by this test shall meet or exceed the accuracy requirements of this specification. Microburst and gust front detections on the simulated data must match the Government supplied correct algorithm outputs with a detection probability of at least 0.98 and a probability of an alarm being false of 0.02.

NOTE: This test is designed to verify that the data quality functions implemented in the signal processor are adequate to support the weather processing algorithms in the RPG. Test cases and weather event models are chosen to stress the signal processor, and adequate performance (compared to the algorithm operating on the ideal data) on this small set of test cases will provide confidence that the specific system implementation fully supports the meteorological processing algorithms. The choice of PRF is determined by the spatial distribution of weather at long ranges. Since the TDWR should detect microbursts over the airport for any PRF that was necessitated by the out of trip weather, performance must be verified for a representative set of the possible PRF values.

4.2.1.14 Radome/External Equipment Environmental Tests. The Radome/External Equipment shall be tested to meet all functional and performance requirements, under the ambient conditions specified in FAA-G-2100 for Environment III.

4.2.1.14.1 Additional Environmental Tests The following tests shall be performed in accordance with MIL-STD-810:

a.	Solar Radiation	Method 505.2	Procedure II
b.	Rain	Method 506.2	Procedure III
c.	Humidity	Method 507.2	Procedure III
d.	Fungus	Method 508.3	
e.	Salt Fog	Method 509.2	Procedure I
f.	Sand and Dust	Method 510.2	Procedure I & II
g.	Transit Drop	Method 516.3	Procedure IV

4.2.1.6.15 System Environmental Conditions. The following tests shall be performed in accordance with MIL-STD-810. These environmental tests shall verify the requirements specified in the VRTM.

a.	Humidity	Method 507.2	Procedure III
b.	Fungus	Method 508.3	
c.	Salt Fog	Method 509.2	Procedure I
d.	Transit Drop	Method 516.3	Procedure IV

4.2.2 Type Test. The Type Test shall be performed over the range of service conditions of and in accordance with FAA-G-2100. The Type Test shall verify the requirements specified in the VRTM. A complete TDWR shall be tested. The antenna radome subsystem type testing may be performed separately.

4.2.3 System Reliability

4.2.3.1 Reliability Demonstration. A reliability demostration shall be conducted in accordance with MIL-STD-781, for fixed ground equipment using thermal stress category A of Appendix B, paragraph 50.1. Test Plan IVC shall be used to demonstrate MTBF and Test Plan VIC shall be used to demonstrate MTBCF. For both Test Plans, the acceptable MTBF and MTBCF (theta 0) for the TDWR system, shall be the values specified in 3.4. Both Test Plans may be conducted concurrently, however, failure data shall be collected for both tests through completion of both tests and evaluated in the respective test reports. The test shall demonstrate that the equipment satisfies the reliability/availability requirements of 3.4.

4.2.3.1.1 Software Failures. Relevant software failures shall be counted as failures.

4.2.4 System Maintainability.

4.2.4.1 System Maintainability Demonstration. A maintainability demonstration shall be performed in accordance with MIL-STD-471, Test Method 9, and Notice 2. The demonstration shall verify that the equipment under test satisfies the mean and maximum repair time requirements of 3.4.2.2.1 and 3.4.2.2.3 respectively, the Mean Preventive Maintenance time requirements of 3.5.1.4, and the Fault Detection/Isolation requirements of 3.4.2.4.

4.2.5 FCC Type Acceptance and Registration Procedures. FCC Type Acceptance and Registration Procedures shall be performed in accordance with FAA-G-2100.

4.2.6 On-Site DQT. The On-site DQT requirements for the TDWR shall be performed by the Contractor and witnessed by the Government at a Government designated site.

4.2.6.1 Weather Processing Demonstration. This demonstration shall be an end-to-end system test using GFI base data set. All weather processing, weather reporting functions, and associated specification performance parameters and tolerances described in Section 3 shall be met and demonstrated.

4.2.6.2 Interface Tests. The following interface tests shall be performed:

a. Demonstrate that the TDWR can interface and operate compatibly with the external interfaces defined in Section 3.1.7.

b. Demonstrate that the TDWR can interface and operate compatibly with the Situation Display and the Ribbon Display in the worst case configuration (e.g; maximum line lengths and modem configurations).

As many interfaces and functions shall be active for these tests as facility operational requirements permit.

4.2.6.3 Remote Monitoring Subsystem. A demonstration of the operation, ease of calibration, and effectiveness of the RMS shall be performed. This shall include performance monitoring, diagnostics, field parameters selection, and the suitability of the RMS test equipment for use during corrective maintenance. A remotely initiated and monitored performance test shall demonstrate that the TDWR system can be certified to meet the performance requirements of Section 3.0.

4.2.6.4 Environmental Characteristics. The TDWR impact on the environmental characteristics shall be demonstrated at the site. This will include, but is not limited to, the following:

a. Interior building temperature control as affected by transmitter heat transfer and ventilation.

b. General characteristics of heat transfer from electronic equipment cabinets.

c. Interior audible noise levels shall be measured to insure that the noise level produced during normal system operation does not exceed limits specified in FAA-G-2100.

d. All ionizing and nonionizing radiation leakage levels shall be within limits.

e. Operation of environmental equipment and controls.

4.2.6.5 Continuous Operation Installation Site Test. A 72 hour continuous operation field test shall be performed to demonstrate compliance with requirements. During this test, the TDWR system shall meet all system specification requirements without failure of hardware or software. Any failure shall require a rerun of the 72 hour test once the failure is remedied. At the end of this period, the equipment shall meet all applicable specification requirements. This test shall be satisfactorily completed prior to the start of TFThis test shall be performed at all subsequent sites.

4.2.6.6 Technical Field Test and Evaluation. TFTll be conducted by the Government and performed by the contractor. TFTll demonstrate TDWR operational effectiveness and the functionality and user interfacing of the displays. TFTll demonstrate that the TDWR meets human engineering requirements including accessibility, man-machine interfaces, and the system response to human command inputs. TFTll provide evaluation of product response times and output formats.

4.2.7 **PAT&E**. A complete series of production tests shall be performed on all equipment delivered under the provisions of this contract. These tests shall ensure compliance to all system level hardware and software requirements of this specification. The following tests, and the tests contained in the VRTM, shall be defined in the Contractor's Test Plan.

4.2.7.1 24 Hour Continuous System Operation Test. After completion of all production tests, each radar shall be aligned, in accordance with the TDWR instruction manuals, and allowed to operate for a period of 24 continuous hours without readjustment. During this test, the TDWR must meet system requirements without failure of hardware and/or software. Any failure shall require a rerun of the 24 hour test after the failure is remedied. This test shall be completed prior to each system delivery.

4.2.7.2 Factory Pedestal Run-In Test. A 168 hour factory run-in test shall be performed on each production pedestal assembly including rotary joints with RF power, electrical, and mechanical loads applied that simulates the various system operational scan strategies of the pedestal.

4.2.7.3 Pedestal Type Testing. The selected type test pedestal per FAA-G-2100 shall be run an additional 72 hours at the factory under the worst combinations of service and environmental conditions under simulated loads, per 4.2.7.2. Measurements of RF power, electrical power input variations, temperature rise of critical pedestal and drive mechanisms, and azimuth/elevation data accuracy shall be recorded for each unit to ensure compliance with the specification.

4.2.7.4 Not used.

4.2.7.5 Antenna Pattern Tests. Antenna Pattern Test specified in 4.2.1.5 and all subparagraphs shall be performed.

4.2.8 **Key Site Installation, Checkout, and Acceptance**. Key Site Installation, Checkout, and Acceptance tests shall be performed on the first operational system at a site designated by the Government.

4.2.8.1 Key Site Installation, Checkout, and Acceptance Test Procedures. The installation and test procedures shall be validated at the key site and used for all subsequent site installations.

4.2.8.2 Continuous Operation Installation Site Test. A 72 hour continuous operation field test shall be performed to demonstrate compliance with requirements. During this test, the TDWR system shall meet all system specification requirements without failure of hardware or software. Any failure shall require a rerun of this 72 hour test once the failure is remedied. At the end of this period, the equipment shall meet all specification requirements.

4.2.8.3 Power Consumption. Total power consumption shall be measured at the TDWR service entrance on commercial power and then measured on backup power. Power consumption for each operational option shall be measured for the following service conditions:

a. Normal operation, 24 hours a day unattended.

b. Attended, maintenance or operational mode, under worst case conditions of day/night and summer/winter conditions.

4.2.8.3.1 Maximum Power Consumption. Maximum power consumption shall be less than the values specified in Section 3.

4.2.8.3.2 Power Consumption Recording. Power consumption for the above conditions shall be logged for the key site and all subsequent sites.

4.3 Formal Test Constraints. A special test device to simulate external interfaces shall be developed by the contractor for use during all formal testing where the external interface is not available. This device will provide the full complement of test data input signals necessary to validate all system functional and performance requirements. Installation and testing shall not interfere with Air Traffic operations.

4.4 Not Used.

Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.0	Requirements						Title
3.1	System Definition						Description
3.1.1	Mission						Description
3.1.2	TDWR Products						Appendix A
3.1.3	System Modes and States	T	D	D		D	
3.1.3.1	Monitoring Mode	T	D	D		D	
3.1.3.2	Hazardous Weather Mode	T	T	T		D	
3.1.3.3	Selection	T		T	T	D	
3.1.3.4	Maintenance Mode	T		T	T	D	
3.1.4	System Functions						Description
3.1.4.1	Radar Data Acquisition (RDA) System Function						Description
3.1.4.1.1	Antenna Group						Title
3.1.4.1.1.1	Antenna Group Dynamic Response	AT		T			
3.1.4.1.1.2	Main Beam Pattern Characteristics	AT		T			
3.1.4.1.1.3	Sidelobe Level Control	AT		T			
3.1.4.1.1.4	Cross Polarization Radiation Levels	AT		T			
3.1.4.1.1.5	RF Beam Positioning Accuracy	T	T	T		T	
3.1.4.1.1.6	RF Beam Positioning Resolution	T	T	T		T	
3.1.4.1.1.7	RF Beam Positioning Repeatability	T	T	T		T	
3.1.4.1.1.8	Pedestal Elevation Drive	AT	T	T	T	T	
3.1.4.1.1.9	Pedestal Azimuth Drive	AT	T	T	T	T	
3.1.4.1.1.10	Pedestal Drive Limit	AT	D	D	D	D	
3.1.4.1.1.11	Duty Cycle	AT					
3.1.4.1.1.12	Antenna Group Environmental Protection	AI					
3.1.4.1.2	Transmitter						Title
3.1.4.1.2.1	Radio Frequency Operation	T	T	T		T	
3.1.4.1.2.2	Klystron	I		I			
3.1.4.1.2.3	X-Radiation Shielding	I		I			

Verification methods: T=Test, D=Demonstration, A=Analyis, I=Inspection, N/U=Not Used

Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.1.4.1.2.4	Arc Protection						Title
3.1.4.1.2.4.1	Transmitter Arc Protection	ID		ID	D	D	
3.1.4.1.2.4.2	Waveguide Arc Protection	DT		DT	DT	D	
3.1.4.1.3	Receiver						Description
3.1.4.1.3.1	Receiver Noise Figure Stability	T		T	T		
3.1.4.1.3.2	Receiver Performance	T		T	T		
3.1.4.1.4	Base Data Collection	AT	T	T	T	T	
3.1.4.1.4.1	Sensitivity	AT	T	T	T	T	
3.1.4.1.4.1.1	Maximum Detection Range	AT	T	T	T	T	
3.1.4.1.4.1.2	Maximum Detection Range For Reflectivity Estimates	AT	T	T	T	T	
3.1.4.1.4.1.3	Minimum Detection Range	AT	T	T	T	T	
3.1.4.1.4.1.4	Maximum Elevation	T	T			T	
3.1.4.1.4.1.5	Maximum Unambiguous Velocity	AT	T			T	
3.1.4.1.4.2	Dynamic Range	AT	T	T	T		
3.1.4.1.4.2.1	Data Collection Dynamic Range	AT	T	T	T		
3.1.4.1.4.3	Radar Data Collection Error Detection	AD	D	D	D	D	
3.1.4.1.4.4	Accuracy	AT					
3.1.4.1.4.4.1	Mean Radial Velocity Measurements	AT	T	T	T	T	
3.1.4.1.4.4.2	Reflectivity Measurements	AT	T	T	T	T	
3.1.4.1.4.4.3	Spectrum Width Estimates	AT	T	T	T	T	
3.1.4.1.4.4.4	Range Error	AT	T	T	T	T	
3.1.4.1.4.4.5	Signal-to-Noise Ratio Measurements	AT	T	T		T	
3.1.4.1.4.5	Sample Interval						Description
3.1.4.1.4.5.1	Azimuth Sample Interval	T		T			
3.1.4.1.4.5.2	Range Sample Interval	T		T			
3.1.4.1.4.5.3	Elevation Sample Interval	T		T			
3.1.4.1.4.5.4	Range Resolution	T		T			
3.1.4.1.4.6	Antenna Rotation Rate	D		D			
3.1.4.1.4.7	Ground Clutter Suppression	T	T	T	T	T	

Verification methods: T=Test, D=Demonstration, A=Analyis, I=Inspection, N/U=Not Used

Table III. Verification Requirements Tracability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Method					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.1.4.1.4.7.1	Ground Clutter Suppression Inhibiting	D		D			
3.1.4.1.4.7.2	No Degradation Due to Inhibiting	D		D			
3.1.4.1.4.8	Clutter Suppression Level Maps	T	T	T	T	T	
3.1.4.1.4.8.1	Clutter Suppression Level Selection	T		T			
3.1.4.1.4.8.2	PPI Clutter Suppression Level Maps	T		T			
3.1.4.1.4.8.3	RHI Clutter Suppression Level Maps	T		T			
3.1.4.1.4.9	Clutter Residue Editing Map	T	T	T	T	T	
3.1.4.1.4.9.1	Clutter Map Range Resolution	T		T			
3.1.4.1.4.9.2	Clutter Residue Editing Map Usage	T		T		D	
3.1.4.1.4.9.3	Site Selectable Maps	D	D	D		D	
3.1.4.1.4.9.4	Angular Resolution	T		T	T		
3.1.4.1.4.10	Clutter Bias Error	AT		T	T		
3.1.4.1.4.11	Base Data Port	I	D	I		D	
3.1.4.1.4.11.1	Base Data Output	D	D	D		D	
3.1.4.1.4.11.2	Base Data Input	D	D	D		D	
3.1.4.1.4.11.3	Base Data Playback	D	D	D		D	
3.1.4.1.4.12	Test Signal Injection	AT					
3.1.4.1.4.13	Clutter RMS Error	AT	T	T	T	T	
3.1.4.1.5	Transmitter-Receiver Chain Stability	T		T	T		
3.1.4.1.5.1	Stability Test Input Signal	T		T	T		
3.1.4.1.5.2	Stability Test Equipment	T		T	T		
3.1.4.1.5.3	Stability Test Points	D	D	D		D	
3.1.4.1.6	Moving Target Simulator	T	T	T	T	T	
3.1.4.1.6.1	Equivalent Target Velocity	T	T	T	T	T	
3.1.4.1.6.2	Carrier	T	T	T	T	T	
3.1.4.1.6.3	Azimuth Adjustment	T	T	T		D	
3.1.4.1.6.4	Elevation Adjustment	T	T	T		D	
3.1.4.1.6.5	Elevation Adjusters	D	D	I	D	D	
3.1.4.1.6.6	Configuration	I	I	I			

Verification Methods: T=Test, A=Analysis, I=Inspection, D=Demonstration, N/U=Not Used

Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DOT	DOT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.1.4.1.6.7	Electrical Power	T	T	T		D	
3.1.4.1.6.8	Moving Target Simulator Usage	T	T	T		D	
3.1.4.1.7	Time Series Port	T		D			
3.1.4.2	Radar Product Generator (RPG) System Function						Description
3.1.4.2.1	N/U						
3.1.4.2.2	Real Time Product Generation						Title
3.1.4.2.2.1	Algorithm Implementation	T	D			T	
3.1.4.2.2.2	Product Generation						Appendix A
3.1.4.2.2.3	Product Priority						Appendix A
3.1.4.2.2.4	Radar and Maintenance Data Identification	D	D				
3.1.4.2.3	Site Dependent Data	T	T	T	T	T	
3.1.4.2.3.1	Site Dependent Data Retention	T	T	T	T	T	
3.1.4.2.4	Data Archiving	T	D	T		D	
3.1.4.2.4.1	Product and Data Storage	T	D	T		D	
3.1.4.2.4.2	Archive Request	T	D	T		D	
3.1.4.2.4.3	Archived Data Erasing	T	D	T		D	
3.1.4.2.5	Control						Title
3.1.4.2.5.1	Operating Mode Select	T	D			D	
3.1.4.2.5.2	PRF Selection	T	D			D	
3.1.4.2.5.3	Programmable Sector Blanking	T	D	T	T	D	
3.1.4.2.5.3.1	Sectors	T	D	T	T	D	
3.1.4.2.5.3.2	Sector Azimuth Selection	T	D	T	T	D	
3.1.4.2.5.3.3	Sector Elevation Selection	T	D	T	T	D	
3.1.4.2.5.4	Data Collection	D	D	D	D	D	
3.1.4.2.5.5	N/U						
3.1.4.2.5.6	N/U						
3.1.4.2.5.7	N/U						
3.1.4.2.5.8	N/U						

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.1.4.2.5.9	Standard Time Source	T	D	T	T	D	
3.1.4.2.5.9.1	Internal Clock	AIT	D	IT		D	
3.1.4.2.6	Interface Ports						Description
3.1.4.2.7	Base Display Generation	D	D	D		D	
3.1.4.3	Remote Monitoring Subsystem (RMS) Function	T	D	T	T	D	
3.1.4.3.1	System Status/Performance Monitoring	T	D	T	T	D	
3.1.4.3.2	Monitoring						Description
3.1.4.3.2.1	Alarm/Alert Processing	T	D	T		D	
3.1.4.3.2.2	Alarm/Alert Parameters	T	D	T	T	D	
3.1.4.3.2.3	Alarm/Alert Disabling	T	D	T	T	D	
3.1.4.3.2.3.1	Alarm/Alert Enabling	T	D	T	T	D	
3.1.4.3.2.4	Alarm/Alert Disable Reporting	T	D	T	T	D	
3.1.4.3.2.5	RMS Alarm/Alerts	AT	T	T	T	T	
3.1.4.3.2.6	RMS Independence	T	D	T		D	
3.1.4.3.3	Local Data File	T	D	T	T	D	
3.1.4.3.4	Data Report	T	D	T	T	D	
3.1.4.3.5	Operating Status	T	D	D	D	D	
3.1.4.3.6	System Status Report	T	D	D	D	D	
3.1.4.3.7	Parameter Reporting	T	D	T	T	D	
3.1.4.3.8	Time Tag	D	D	D		D	
3.1.4.3.9	Return-To-Normal Message	T	D	D	D	D	
3.1.4.3.10	MDT Local Control	D	D	D		D	
3.1.4.3.11	Diagnostic Test Data	T	D	T	T	T	
3.1.4.3.12	Facility Data	T	D	T	T	T	
3.1.4.3.12.1	Engine-Generator Control	T	T	T	T	T	
3.1.4.3.13	Control Commands	T	D	T	T	D	
3.1.4.3.14	RMS Mode Change	D	D	D		D	
3.1.4.3.14.1	Return to Automatic Selection	D	D	D		D	
3.1.4.3.14.2	Monitoring Mode	D	D	D		D	

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Table III. Verification Requirements Traceability Matrix

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		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.1.4.3.14.3	System On/Off	D	D	D		D	
3.1.4.3.15	Parameter Adjustment	AT	D	T	T	D	
3.1.4.3.16	Reset	T	D	T	T	D	
3.1.4.3.17	Control and Monitoring of Redundant Equipment	D	D	D		D	
3.1.4.3.18	RMS Control	D	D			D	
3.1.4.3.19	Mode Monitoring	T	D	T	T	D	
3.1.4.3.20	Setting of Internal Clock	T		T	T		
3.1.4.3.20.1	Time Report	D	D	D		D	
3.1.4.3.21	Transmission Cutoff	T	D	T		D	
3.1.4.3.22	Base Data Port Operation	T	D	T	T	D	
3.1.4.3.23	Time Series Port	T	D			D	
3.1.4.3.24	Input/Output Port	I	D			D	
3.1.4.3.24.1	Data Input	T	D	T		D	
3.1.4.3.24.2	Data Display	T	D	T		D	
3.1.4.3.25	Message Transfer	T	D	T	T	D	
3.1.4.3.26	Certification Test	T	T	T	T	T	
3.1.4.3.26.1	Certification Test Data	T	T	T	T	T	
3.1.4.3.27	Performance Characteristics	A					
3.1.4.3.27.1	Alarm/Alert Detection	AT	T	T	T	T	
3.1.4.3.27.2	Change of Operational Mode Detection	T	T	T	T	T	
3.1.4.3.27.3	Performance Data Report	T	T	T	T	T	
3.1.4.3.27.4	Control Commands	T	T	T	T	T	
3.1.4.3.27.5	Command Acknowledgment	T	T	T	T	T	
3.1.4.3.27.6	Message Transfer	T	D	T	T	D	
3.1.4.3.27.7	N/U						
3.1.4.3.27.8	Message Priority	T	T	T	T	T	
3.1.4.3.28	Command Subset	AT	T			T	
3.1.4.3.29	Equipment Protection	AT	D			D	
3.1.4.3.29.1	RMS Fault Protection	T	D			D	
3.1.4.3.30	Protection from Improper Command	AT	T			T	
3.1.4.3.30.1	Protection From Inadvertent Mode Change	D					

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.1.4.4	Display Function						Description
3.1.4.4.1	System Control	T	D	T	T	D	
3.1.4.4.2	Display Functional Unit	D					
3.1.4.4.2.1	Situation Display	T	T	T		T	
3.1.4.4.2.1.1	Equipment Requirements						Appendix B
3.1.4.4.2.2	Ribbon Display	T	T	T	T	T	
3.1.4.4.2.2.1	Equipment Requirements						Appendix B
3.1.4.4.2.3	DFU Communication	T	T	T	T	T	
3.1.4.4.2.3.1	DFU Spare Port	T	D	T		D	
3.1.4.4.2.4	Verification	T	T	T	T	T	
3.1.4.4.2.5	Backup of Communications	T	T	T	T	T	
3.1.4.4.2.6	Alternate Communications Configuration	T	T	T	T	T	
3.1.4.4.2.7	Ribbon Message Destination	T	D	T		D	
3.1.4.4.2.7.1	Runway Reference	D	D			D	
3.1.4.4.2.7.2	No Runway Reference	D	D			D	
3.1.4.4.3	Hazardous Weather Warnings	T	T			T	
3.1.5	System Functional Relationships						Description
3.1.6	Configuration Allocation						Title
3.1.7	Interface Requirements						Title
3.1.7.1	External Interface						Title
3.1.7.1.1	External Systems Description						Description
3.1.7.1.1.1	N/U						
3.1.7.1.1.2	Tower Control Computer Complex	T	T	T		T	
3.1.7.1.1.3	Low Level Windshear Alert System (LLWAS)						Reserved
3.1.7.1.1.4	Air Traffic Control Tower	T	T	T		T	
3.1.7.1.1.5	Terminal Radar Approach Control Facility	T	T	T		T	
3.1.7.1.1.6	Remote Maintenance Monitoring System	T	T	T		T	
3.1.7.1.1.6.1	Maintenance Data Terminal	T	T	T		T	
3.1.7.1.1.7	Base Data Recorder	D	D	D		D	

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.1.7.1.1.8	Time Series	D	D	D		D	
3.1.7.1.1.9	Base Data and Product Display	D	D	D		D	
3.1.7.1.2	External Interface Identification						Description
3.1.7.1.3	Hardware-to-Hardware External Interfaces	A					
3.1.7.1.3.1	Physical Protocol	IT		T			
3.1.7.1.3.2	Communication Port Requirements						Title
3.1.7.1.3.2.1	Interface Configuration	I	I	I	I	I	
3.1.7.1.3.2.2	Communication Port Flexibility	AT	T	T	T	T	
3.1.7.1.3.2.3	DFU Communications Port	I		I			
3.1.7.1.3.3	MDT Port	D	D	D		D	
3.1.7.1.4	Hardware-to-Software External Interface						N/A
3.1.7.1.5	Software-to-Software External Interface						Description
3.1.7.2	Internal Interface						N/A
3.1.8	Government Furnished Property List						Title
3.1.8.1	Government Furnished Information (GFI)						Title
3.1.8.1.1	Airport Information Charts						N/A
3.1.8.1.2	Airport Data Package						N/A
3.1.8.1.3	Weather Test Cases						N/A
3.1.8.1.4	N/U						
3.1.8.1.5	N/U						
3.1.8.1.6	Site Radio Frequency (RF) Assignments						N/A
3.1.8.2	Government Furnished Property						Title
3.1.8.2.1	Land Acquisition						N/A
3.1.8.2.2	Right-of-Way						N/A
3.1.8.3	Government Furnished Equipment (GFE)						Title
3.1.8.3.1	Modems						N/A
3.1.8.3.2	Engine-Generator						N/A
3.1.8.3.3	Dedicated Communications Lines						N/A
3.2	System Characteristics						Title
3.2.1	Physical Requirements						Title

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.2.1.1	General Physical System Requirements						Title
3.2.1.1.1	N/U						
3.2.1.1.2	N/U						
3.2.1.1.3	LRU Level	AI		I			
3.2.1.1.4	N/U						
3.2.1.1.5	Panel Controls	AI		I			
3.2.1.1.5.1	Locking Devices						Title
3.2.1.1.5.1.1	Critical Controls	AIT	D			D	
3.2.1.1.5.1.2	Operation of Locking Devices	IT	D			D	
3.2.1.1.5.2	Access	I		I			
3.2.1.1.6	Mechanical	I	I	I		I	
3.2.1.1.7	N/U						
3.2.1.1.8	Nameplates and Product Marking	I		I			Title
3.2.1.1.9	Physical Security	AI	D	I		D	
3.2.1.1.9.1	Intrusion Alarm	T	D	T		D	
3.2.1.1.10	Convenience Outlets	T	D	T		D	
3.2.1.1.11	Hoists and Lifts	AD	D	D		D	
3.2.1.1.12	Lighting	AD	D	D		D	
3.2.1.1.13	Lightning Protection	AI	IT	I		IT	
3.2.1.2	Radome Physical Requirements						Title
3.2.1.2.1	Radome Effects	AT	D			D	
3.2.1.2.2	Radome Enclosure						3.2.2.1.2
3.2.1.2.3	Internal and External Surfaces	AT			T		
3.2.1.2.4	Water Penetration	T	I		T	I	
3.2.1.2.5	Exterior Surface						Title
3.2.1.2.5.1	Hydrophobic Surface	T					
3.2.1.2.5.2	Exterior Deterioration	AT					
3.2.1.2.5.3	Protective Coating	AI		I			
3.2.1.2.6	Ice or Snow Adhesion	AT					

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.2.1.2.7	Flammability and Combustibility	T					
3.2.1.2.8	Effects of Temperature	T					
3.2.1.2.9	N/U						
3.2.1.2.10	Radome Nameplate or Product Markings	I					
3.2.1.2.11	Radome Ventilation	AI	D	I		D	
3.2.1.2.12	Aircraft Obstruction Lights						Title
3.2.1.2.12.1	Type	I		I			
3.2.1.2.12.2	Installation	I	I			I	
3.2.1.2.12.3	Access	D	D			D	
3.2.1.2.12.4	Radome	D	D			D	
3.2.1.3	Antenna Pedestal Physical Requirements						Title
3.2.1.3.1	Support	A					
3.2.1.3.2	Control	T	T	T	T	T	
3.2.1.3.2.1	Off Mode	T	T	T	T	T	
3.2.1.3.2.2	Off Stow Lock	D	D	D	D	D	
3.2.1.3.2.3	Local Maintenance Mode	T	T	T	T	T	
3.2.1.3.2.4	Remote Mode	T	T	T	T	T	
3.2.1.3.3	Mechanical Requirements						Title
3.2.1.3.3.1	Azimuth Rotation	T	D	T	T	D	
3.2.1.3.3.2	N/U						
3.2.1.3.3.3	Limits, Stops, and Braking	IT	D	IT		D	
3.2.1.3.3.3.1	Elevation Brake	IT	D	IT		D	
3.2.1.3.3.4	Structural Height	IT	I			I	
3.2.1.3.3.5	RF Transmission	T	D	T	T	D	
3.2.1.3.3.6	Pressurization	T	D	T	T	T	
3.2.1.3.3.7	Waveguide	I	I	I		I	
3.2.1.3.3.8	Alignment	AIT	D	IT	IT	D	
3.2.1.3.3.9	Maintenance Requirements						Title
3.2.1.3.3.9.1	Disable Switch	D	D	D		D	
3.2.1.3.3.9.2	Communication	D	D	D		D	

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.2.1.3.3.9.3	Access	AD	I	I		I	
3.2.1.3.3.10	Local Control Box	I	I	I		I	
3.2.1.3.3.10.1	Azimuth Manual Controls	T	D	T		D	
3.2.1.3.3.10.2	Elevation Manual Controls	T	D	T		D	
3.2.1.3.3.10.3	Readouts	T	D	D		D	
3.2.1.3.3.10.4	Antenna Stow Lock Position	D	D	D		D	
3.2.1.3.3.10.5	Antenna Stow Lock Elevation	T	D	T		D	
3.2.1.4	Breakdown	AD					
3.2.1.5	Tower Physical Requirements	AI	I	I		I	
3.2.1.5.1	Tower Height	I	I			I	
3.2.1.5.2	Tower Stability	A	T			IT	Test at Key-Site
3.2.1.5.3	Access	AD	I			I	
3.2.1.5.4	Tower Foundation	A	AI	A		AI	
3.2.1.5.4.1	Concrete Structures/Foundation	A	AI			I	
3.2.1.5.4.2	Foundation Depth	A	AI	A		AI	
3.2.1.5.4.3	Piers, Pedestals, Etc.	A	AI	A		AI	
3.2.1.5.4.3.1	Base Plates		I			I	
3.2.1.5.4.3.2	Grout		I			I	
3.2.1.5.4.4	Concrete Forms		I			I	
3.2.1.5.5	Tower Tilting	A	D			D (Key-Site Only)	
3.2.1.6	Physical Facility Requirements	AT	I			I	
3.2.1.6.1	Installation of Government Furnished Engine-Generator		I				
3.2.1.6.2	TDWR System Installation		ID			ID	
3.2.2	Environmental Conditions						Title
3.2.2.1	Operating Environment						Title
3.2.2.1.1	Controlled Environment	AT			T		
3.2.2.1.2	Uncontrolled Environment	AT			T		
3.2.2.1.3	Additional Environmental Requirements	AT			T		
3.2.2.2	Non-Operating Environment	AT			T		
3.2.2.3	Induced Environment	A					
3.2.3	N/U						

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Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.2.4	Materials, Processes and Parts	A					
3.2.4.1	Finish and Color	AI		I			
3.2.4.1.1	Tower Finish	AT		I			
3.2.4.2	Structural Material						Title
3.2.4.2.1	Aluminum Alloy	I					
3.2.4.2.2	Light Steel	I					
3.2.4.2.3	Welding	I					
3.2.4.3	Dissimilar Materials	I		I			
3.2.4.4	General Design Requirements						Title
3.2.4.4.1	Design and Construction	IT		IT			
3.2.4.4.1.1	Commercial Available Equipment	A					
3.2.4.4.1.1.1	Government Approval	I		I			
3.2.4.4.1.1.2	Request for Government	I		I			
3.2.4.4.2	Modular Construction	AD		I			
3.2.4.4.3	Microprocessor Standardization	A					
3.2.4.4.4	Microcontrollers Standardization	A					
3.2.4.4.5	Solid State Design	A					
3.2.4.4.6	Circuit Design	A					
3.2.4.4.7	Nonredundant Operation	D			D		
3.2.4.4.7.1	Dummy Load	D	D	D		D	
3.2.4.4.8	Accessibility	AD					
3.2.4.4.9	Useful Life	A					
3.2.4.4.10	Electrical Power						Title
3.2.4.4.10.1	Primary Power Requirements	T		T			
3.2.4.4.10.2	Design Center Voltages	IT	I	T		I	
3.2.4.4.10.3	Power Loss						Title
3.2.4.4.10.3.1	Power Loss of 3 Minutes Or Less	T	D	T	T	D	
3.2.4.4.10.3.2	Power Loss of Greater Than 3 Minutes	T	D	T	T	D	
3.2.4.4.10.3.3	Backup Power	T	T	T		T	
3.2.4.4.10.3.4	Engine Generator Run Time	AT	T			T	Fuel Level & Alarm
3.2.4.4.10.3.5	Maximum Engine Generator Power	AT	T	T	T	T	

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Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.2.4.4.10.4	Maximum Power Consumption	AT	T	T		T	
3.2.4.4.10.5	Voltage Regulators	I					
3.2.4.4.11	Non-propagation of Failures	AI					
3.2.4.4.12	Adjustment	T	T			T	
3.2.4.5	Wind Loading	AT					
3.2.5	Electromagnetic Interference	AT					
3.2.5.1	Electromagnetic Compatibility, Electromagnetic Interference, and Radio Frequency Interference	AT	T	T		T	
3.2.5.1.1	Emissions (Conducted)	AT	T	T		T	
3.2.5.1.2	Emisssions (Radiated)	AT	T	T		T	
3.2.5.1.3	Susceptibility (Conducted)	AT	T	T		T	
3.2.5.1.4	Susceptibility (Radiated)	AT	T	T		T	
3.2.5.1.5	Cross-Talk, Shielding and Isolation	A					
3.2.5.1.5.1	Shielding	A		I			
3.2.5.1.5.2	Wire Position	A		I			
3.2.6	Workmanship	I	I	I		I	
3.2.7	Interchangeability	A		I			
3.2.8	Saftey	AI	I	I		I	
3.2.8.1	N/U						
3.2.8.2	Work Platforms	A	I			I	
3.2.8.3	Weight Limitations	AT		T			
3.2.8.3.1	Weight/Center of Gravity	IT		IT			
3.2.8.3.2	Lifting Attachments	AI		I			
3.2.8.4	Microwave Radiation Exposure	T		T			
3.2.8.5	Safety Program	AI		I			
3.2.9	Human Performance/Human Engineering	AI	I	I			
3.2.10	N/U						
3.2.11	N/U						
3.2.12	Software Development						Title
3.2.12.1	Software Requirements	AI					
3.2.12.1.1	Commercially Available Software	AI					
3.2.12.2	Programming Language(s)	AI					

Verification Methods: T=Test, D=Demonstration, A=Analyis, I=Inspection, N/U=Not Used

Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.2.12.2.1	Algorithms	I					
3.2.12.2.2	Programming Language	I					
3.2.12.3	Operability	T					
3.2.12.3.1	Protection from Inappropriate Commands	D	D				
3.2.12.4	Logical and Physical Independence	A					
3.2.12.5	Data Retrieval	T	T			D	
3.2.12.6	Fault Recovery	AT	T			D	
3.2.12.7	Load Message	T	D			D	
3.2.12.8	System Software Revisions	D					
3.3	Processing Resources						Title
3.3.1	System Controller, Data Processing, and Signal Processing, Processing Resources						Title
3.3.1.1	Computer Hardware Requirements						Title
3.3.1.1.1	Automatic Data Processing (ADP) Security	AD					
3.3.1.1.2	Loading	AT	D			D	
3.3.1.1.3	N/U						
3.3.1.1.4	Auxiliary Storage Requirements	AT	T			T	Test RMS monitored storage only at site.
3.3.1.2	N/U						
3.3.1.3	N/U						
3.3.1.4	Computer Processor Utilization						Title
3.3.1.4.1	Computer Performance Monitoring (CPM)	T	D			D	
3.3.2	Off-Line Storage of System Controller Software	T	T			D	From RMS Demo. at site.
3.4	Quality Factors						Title
3.4.1	Reliability	ADT					
3.4.1.1	Applicability	A					
3.4.1.2	N/U						
3.4.1.3	Hardware Reliability	A					
3.4.1.3.1	Mean Time Between Critical Failure	AT					

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance testing	Remarks
3.4.1.3.2	Mean Time Between Failure	AT					
3.4.1.4	Software Reliability	AT					
3.4.2	Maintainability	A					
3.4.2.1	Applicability	A					
3.4.2.2	Allocation	A					
3.4.2.2.1	Mean Time To Repair	AT					
3.4.2.2.2	Mean Bench Repair	AT					
3.4.2.2.3	Maximum Corrective Maintenance Time	AD					
3.4.2.3	Flexibility and Expansion						Title
3.4.2.3.1	Processing Power Expansion	AT					
3.4.2.3.2	Provision of Display	AD	D			D	
3.4.2.4	Automatic Fault-Isolation	AT		D			
3.4.2.4.1	Residue Faults	AT	D			D	
3.4.2.4.2	Automatic Fault-Isolation False Alarm Rate	AT					
3.4.3	Availability	AT					
3.4.4	N/U						
3.4.5	N/U						
3.5	Logistics						Description
3.5.1	Support Concept						Title
3.5.1.1	Restoration	D		D			
3.5.1.2	N/U						
3.5.1.3	Maintenance Concept						Description
3.5.1.3.1	Levels of Maintenance	A					
3.5.1.4	Maximum Maintenance	A					
3.5.1.4.1	Preventive Non-Critical Corrective Maintenance	A					
3.5.1.4.2	N/U						
3.5.1.4.3	Ease of Maintenance	D					
3.5.1.4.4	Software Maintenance	D	D			D	Demo at Key-Site only.
3.5.1.5	Supply Support						Description
3.5.1.6	Instruction Manuals	I					
3.5.1.7	Special Test Equipment						Title

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					Remarks
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
3.5.1.7.1	Portable Base Data and Product Display	D	D	D		D	
3.5.1.7.2	Base Data Recorder	T	T	T		T	
3.5.2	Support Facilities						Title
3.5.2.1	Hardware Support	IT				IT	IT at FAAAC
3.5.2.2	Program Support Facility (PSF)	IT				IT	IT at FAAAC
3.5.2.2.1	Support Computers						Title
3.5.2.2.1.1	Functions Supported	D				D	At FAAAC
3.5.2.2.1.2	Performance	A					
3.5.2.2.1.2.1	Base Data Playback	T				D	At FAAAC
3.5.2.2.1.2.2	Software Development and Test	T				D	At FAAAC
3.5.2.2.1.2.3	Simultaneous Operation	T				D	At FAAAC
3.5.2.2.1.3	System Software Generation	D				D	At FAAAC
3.5.2.2.2	Support Computer Peripherals	D				D	At FAAAC
3.5.2.2.2.1	Interactive Video Displays	T				D	At FAAAC
3.5.2.2.2.2	Weather Data and Product Displays	T				D	At FAAAC
3.5.2.2.2.3	Magnetic Disk Storage	T				D	At FAAAC
3.5.2.2.2.4	Alphanumeric Hard Copy	T				D	At FAAAC
3.5.2.2.2.5	Graphics Hard Copy	T				D	At FAAAC
3.5.2.2.2.6	Magnetic Tape Drives	T				D	At FAAAC
3.5.2.2.2.7	Base Data Playback	T				D	At FAAAC
3.5.2.2.2.8	Archive Product Playback	T				D	At FAAAC
3.5.2.2.3	Firmware Support Equipment	D				D	At FAAAC
3.5.2.2.4	Expandability	T				D	At FAAAC
3.5.2.2.5	N/U						
3.5.2.2.6	System Utilities	D				D	At FAAAC
3.5.2.2.7	N/U						
3.5.2.2.8	Portable Display	D				D	At FAAAC
3.5.3	N/U						
3.5.4	Personnel						Title
3.5.4.1	Maintenance Personnel	D					
3.5.5	Training	I					
3.6	Precedence						Description

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
10.	Purpose						Description
10.1	Product Generation and Transmission	T	T			D	
10.1.1	Product Priority	T	T			D	
10.1.2	Product Distribution	T	T			D	
10.2	Microburst Product	AD	D			D	Key-Site Only
10.2.1	Performance Design Goal	A					
10.3	Gust Front Product	AT	D			D	
10.4	N/U						
10.5	Precipitation Product	D					
10.5.1	Levels	T	D			D	Based on available conditions.
10.5.2	Computation of Precipitation Product						Title
10.5.2.1	Base Data Used	T	D			D	
10.5.2.2	Update Rate	T	D			D	
10.5.2.3	Product Format	T	D			D	
10.5.2.4	Definition of Cell Value	A					
10.5.3	Attenuation	AT					
20.1	Introduction						Description
20.1.1	Situation Display Requirements						Title
20.1.1.1	General Requirements						Title
20.1.1.1.1	Size	I		I			
20.1.1.1.2	Start-up Characteristics	D	D			D	
20.1.1.1.3	Memory	D	D				
20.1.1.1.4	Environment	T			T		
20.1.1.1.5	Readability	D	D			D	
20.1.1.1.6	Lifetime	A					
20.1.1.1.7	Color	D	D				
20.1.1.1.8	Protection of Display Adaptation Parameters	D	D			D	
20.1.1.2	Message Types						Title
20.1.1.2.1	Alphanumeric	D	D	D		D	
20.1.1.2.2	Graphic	T					

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Table III. Verification Requirements Traceability Matrix

Section 3: Requirements Paragraph Reference		Verification Test Level and Methods					
		DT&E		Production		Acceptance Testing	
		In-Plant	On-Site	In-Plant			
Paragraph No.	Title	DQT	DQT/ TFT&E	PATE	Type	Installation, Checkout, and Acceptance Testing	Remarks
20.1.1.3	Input Device						Title
20.1.1.3.1	Keyboard	I					
20.1.1.4	Alarms						Title
20.1.1.4.1	Visual	D	D	D		D	
20.1.1.4.2	Audible	T	D	T		D	
20.1.1.4.3	Disable	D	D	D		D	
20.1.1.5	Commands						Title
20.1.1.5.1	Command Acceptance	D	D	D		D	
20.1.1.5.2	Operation	D	D			D	
20.1.1.5.3	Display Adaptation Parameters	D	D			D	
20.1.1.5.4	Update	D	D			D	
20.1.1.6	Display Formats						Title
20.1.1.6.1	Format	D	D			D	
20.1.1.6.2	Color	D	D			D	
20.1.1.7	Power	T	T			T	
20.1.1.8	Background Map	T	D	T		D	
20.1.1.9	N/U						
20.1.2	Ribbon Display Requirements						Title
20.1.2.1	General Requirements						Title
20.1.2.1.1	Size	AI	I	I		I	
20.1.2.1.2	Start-up Characteristics	D	D			D	
20.1.2.1.3	Environmental	T			T		
20.1.2.1.4	Readability	D	D			D	
20.1.2.1.5	Lifetime	A					
20.1.2.2	Message Type	D					
20.1.2.3	Input Device	D	D	D		D	
20.1.2.4	Alarms						Title
20.1.2.4.1	Visual	D	D	D		D	
20.1.2.4.2	Audible	T	D	T		D	
20.1.2.5	Power	T	T	T		T	

Verification methods: T=Test, D=Demonstration, A=Analyis, I=Inspection, N/U=Not Used

5. PREPARATION FOR DELIVERY.

5.1 Preservation and Packaging.

5.1.1 Hardware Items Not for Turnkey Installation.

5.1.1.1 Preservation and Packaging. Hardware items not intended for turnkey shall be individually preserved and packaged in accordance with MIL-E-17555, Level A, Method II. Common hardware (e.g., lamps, fuses, nuts and bolts) shall be exempt from individual packaging.

5.1.1.2 Items Sensitive to Electrostatic Discharge. Items sensitive to electrostatic discharge shall be packaged in accordance with DOD-STD-1686.

5.2 Packing.

5.2.1 Hardware Item Not for Turnkey Installation.

5.2.1.1 Packing. Packing of hardware items not intended for turnkey installation shall be in accordance with MIL-E-17555, Level B.

5.2.1.2 Number in Each Package. No more than one set of equipment and associated items shall be packed in each shipping container.

5.2.1.3 Items Sensitive to Electrostatic Discharge. Items sensitive to electrostatic discharge shall be packed in accordance with DOD-STD-1686.

5.3 Marking.

5.3.1 Information on Shipping Container. Each package and shipping container shall be durably and legibly marked in accordance with MIL-STD-129 including the following information:

Name of Item and FAA Type Designation
Serial Number(s)
Quantity
Contract Number
Federal Stock Number
Gross Weight of Container
Manufacturer's Name

5.3.2 Bar Coding Marking. Each package, replaceable item, and its container shall be marked and bar coded, in accordance with MIL-STD-129.

6. NOTES.

6.1 Acronyms.

AA	Aluminum Association
AC	Alternating current
ACCC	Area Control Computer Complex
ACI	American Concrete Institute
A/D	Analog to Digital
AGC	Automatic Gain Control
AGL	Above Ground Level
ANSI	American National Standards Institute
AMP	Amperes
ARP	Airport Reference Point
ASCII	American Standard Code for Information Interchange
ASTM	American Standards Testing Methods
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
AWS	American Welding Standard
BITE/BIT	Built in test equipment/Built in test
BIT/FIT	Built in test/Fault isolation test
C	Celsius
CFR	Code of Federal Regulations
COTS	Commercial Off-the-Shelf
CPM	Central Performance Monitoring
CPU	Central Processing Unit

CSER	Contractor Site Engineering Report
dB	Decibels
dBA	dB Acoustic
dBz	Reflectivity factor in decibels
DF	Display Function
DFU	Display Functional Unit
DOD	Department of Defense
DOT	Department of Transportation
DQT	Design Qualification Test
E/G	Engine Generator
EIA	Electronic Industries Association
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read Only Memory
EEPROM	Electronic Erasable Programmable Read Only Memory
F	Fahrenheit
f_o	Operating frequency
FAA	Federal Aviation Administration
FMC	Full Mission Capability
GFE	Government Furnished Equipment
GFI	Government Furnished Information
GFP	Government Furnished Property
GHz	Gigahertz
HOL	Higher Order Programming Language

HVAC	Heating, Ventilating, and Air-Conditioning
Hz	Hertz
I and Q	In-phase and quadrature
ICD	Interface Control Document
I/O	Input/output
ISO	International Organization for Standards
IRD	Interface Requirements Document
kHz	Kilohertz
km	Kilometers
LLWAS	Low Level Wind Shear Alert System
LRU	Line Replaceable Unit
MBR	Mean Bench Repair
MDT	Maintenance Data Terminal
MHz	Megahertz
MIL	Military
mm	Millimeters
MPS	Maintenance Processor Subsystem
m/sec	Meters per second
MTBCF	Mean Time Between Critical Failure
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
MXCMT	Maximum Corrective Maintenance Time
NAILS	National Airspace Integrated Logistics Support
NAS	National Airspace System

NB	Narrow band
nmi	Nautical mile (s)
nom.	Nominal
NFPA	National Fire Protection Association
NTIA	National Telecommunication and Information Administration
NVRAM	Non-volatile Random Access Memory
OSHA	Occupational Safety and Health Administration
PAT&E	Production Acceptance Test & Evaluation
Pd	Probability of detection
PPI	Plan Position Indicator
PRF	Pulse repetition frequency
PROM	Programmable Read Only Memory
psi	Pounds per square inch
PSF	Program Support Facility
QT&E	Qualification Test and Evaluation
RAM	Random Access Memory
RBDT	Ribbon Display
RDA	Radar Data Acquisition
RF	Radio Frequency
RFI	RF Interference
RHI	Range Height Indicator
RMMS	Remote Maintenance Monitoring Subsystem
RMS	Remote Monitoring Subsystem
rms	Root mean square

RMSC	Remote Monitoring Subsytem Concentrator
ROM	Read-Only-Memory
RPG	Radar Product Generator
RSEC	Radar Spectrum Engineering Criteria
S/C	Signal to Clutter Ratio
sec	Second(s)
SD	Situation Display
SDP	Software Development Plan
SNR	Signal-to-Noise Ratio
STD	Standard
TCCC	Tower Control Computer Complex
TDWR	Terminal Doppler Weather Radar
TFT&E	Technical Field Test and Evaluation
TRACON	Terminal Radar Approach Control Facility
US	United States (of America)
usec	Microsecond
uV	Microvolt
VRTM	Verification Requirements Traceability Matrix
VSWR	Voltage Standing Wave Ratio

6.2 Definitions.

6.2.1 Alarm. An alarm is a TDWR generated response to a condition which requires immediate attention. The TDWR has two types of alarms - weather product and maintenance.

6.2.1.1 Weather Product Alarm. A weather product alarm is generated in response to a detected hazardous weather condition in a preselected area of concern.

6.2.1.2 Maintenance Alarm. A maintenance alarm is a TDWR generated response to any condition which could cause the system to become non-operational or cause erroneous data product generation.

6.2.2 Alert. An alert is a TDWR generated response to any out-of-tolerance condition. There are two types of alerts, a secondary alert and a maintenance alert.

6.2.2.1 Secondary Alerts. A secondary alert is a TDWR generated response to any condition which may cause imminent damage to the system and may cause either the system to become non-operational or generate erroneous data products.

6.2.2.2 Maintenance Alert. A maintenance alert is any condition which is out-of-tolerance, but an alarm or a secondary alert condition is not imminent. A maintenance alert condition does not have to be addressed until the next scheduled site visit.

6.2.3 Antenna Group. Those items of equipment which satisfy the requirements for the antenna, pedestal, and related waveguide.

6.2.4 Audible and Visual Alarms. An alarm generated from the TDWR hardware and software which can be heard or seen by ATC personnel and which will alert ATC personnel of hazardous conditions.

6.2.5 Availability. Availability is the probability that the TDWR will be at Full Mission Capability (FMC) during any and all required operating times.

6.2.6 Base Data. Base data consists of reflectivity, spectrum width, mean radial velocity, and signal-to-noise ratio estimates for each range-azimuth cell, corrected for clutter, and range and velocity folding.

6.2.7 Beam Filling Target. A weather target which extends across the main beam to at least the half power points.

6.2.8 BIT/FIT. Those test techniques which form an integral part of the TDWR and are designed to either monitor system performance or to isolate a fault or both.

6.2.9 BITE/BIT. Those items of built-in-test-equipment and their respective built-in-tests which perform internal testing of the TDWR.

6.2.10 Certification Test. A test performed after any maintenance action which affects two or more certification parameters or whenever the system integrity is in question.

6.2.11 Certification Test Data. A set of system performance parameters used to validate that the system can be placed in operational use.

6.2.12 Corrective Maintenance. Corrective maintenance consists of those actions directly related to correcting a failure. Corrective maintenance does not include administrative or travel activities.

6.2.13 Critical Failure. A critical failure is any failure which degrades the TDWR's FMC.

6.2.14 dBZ. Radar reflectivity factor of weather scatterers expressed in decibels.

6.2.15 Dissimilar Materials. Metals are dissimilar if they generate electrolysis when placed in contact with each other in accordance with MIL-STD-889. Nonmetals in contact with metals will be considered dissimilar unless there is technical data supporting compatibility. This includes plastics, wood, and concrete.

6.2.16 Equipment. A complete operating assembly, either operating independently or within a system or subsystem.

6.2.17 Equipment Instruction Books. The technical manuals that include the equipment drawings, parts lists, and methods of isolating faults and repairing them.

6.2.18 Failure. A failure is any event that causes the TDWR system to not meet any requirement of this specification.

6.2.19 Full Mission Capability. The level of performance which allows the TDWR to perform its mission within the requirements of this specification.

6.2.20 Gross Weight. Gross weight is the maximum possible weight of the enclosure and its contents.

6.2.21 Ground Clutter Suppression. Ground clutter suppression is described by the improvement in the ability to measure weather parameters in the presence of two different clutter models. Clutter Model A is a Gaussian random process with a Gaussian spectrum centered at zero mean velocity. The clutter spectrum width is the root sum square of 0.1 m/sec plus the root mean squared (rms) spectrum width resulting from the antenna rotation at the lowest two elevation scans. Clutter Model B represents a scattering echo as the antenna scans by a point target and consists of a complex waveform with an amplitude that is an approximation of the two-way antenna pattern. Clutter suppression is defined as the signal-to-clutter power ratio at the input to the system divided by the signal-to-clutter power ratio at the output of the clutter suppression system as shown in Figure 3. If the clutter suppression is accomplished by a linear time invariant filter with unity gain in the passband followed by a conventional weather return parameter estimation process, such as a pulse pair algorithm, the clutter rejection performance is the ratio of filter input power to filter output power for each of the two clutter models.

6.2.22 Gust Fronts. A moving windshift zone separating ambient air from a thunderstorm outflow. Associated with gust fronts are strong updrafts ahead of the front, wind shear in the frontal (windshift) zones, and strong turbulence in the frontal zone and above the outflow directly behind the frontal zone. The wind shift zone associated with a gust front is typically 0.5 nmi in width.

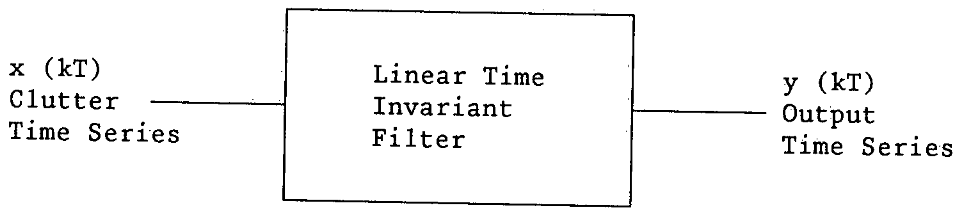
6.2.23 Hazardous Wind Shear. A hazardous wind shear is a strong variation of the longitudinal wind speed along the flight path of an aircraft, sufficient to cause a loss of aircraft performance and sustain a significant loss of altitude.

6.2.24 Inherent Availability. Inherent availability is a measure of the availability which excludes the logistics delay time and administrative delay time.

6.2.25 Line Replaceable Unit (LRU). An LRU consists of one or more electronic/mechanical subassemblies and assemblies, as defined in MIL-STD-280 and applicable parts of MIL-STD-1388-2, and excludes items falling under the definition for a part as given in MIL-STD-280.

6.2.26 Machine Instruction Words. Instructions that computer hardware (a machine) can recognize and execute.

6.2.27 Maintenance Depot. The FAA Depot at Oklahoma City, Oklahoma. Depot-level maintenance shall consist of those maintenance activities performed on unserviceable repairable LRUs and system support/test equipment requiring specialized skills and equipment. The tasks performed at this level are those tasks that are not specifically assigned to the organizational level of maintenance. When the specification states that repair will be at the depot the actual repair may be at the depot or at a contractor's location.



T = Pulse Repetition Time

Clutter Model	Algorithm for Computing Clutter Suppression Capability: I
A	$I = 10 \log_{10}(\langle \lvert x(kT) \rvert^2 \rangle / \langle \lvert y(kT) \rvert^2 \rangle)$
B	$I = 10 \log_{10}(\max \langle \lvert x(kT) \rvert^2 \rangle / \max \langle \lvert y(kT) \rvert^2 \rangle)$

represents the value of the time average over a moving window as the antenna scans past a point target. The window time duration shall correspond to the appropriate weather parameter estimation interval. The scan rate assumed should be that used on the lowest two elevations.

| | represents absolute value.

FIGURE 3
CLUTTER SUPPRESSION CAPABILITY CHARACTERIZATION FOR
LINEAR TIME INVARIANT CLUTTER FILTERING

6.2.28 Maximum Corrective Maintenance Time (MAXCT). MAXCT is the maximum time to isolate, fix, and retest any failed unit. This time is applicable to 95% of all possible failures.

6.2.29 Mean Bench Repair (MBR). MBR is the total LRU bench repair time, to include set up and fault isolation time, repair time, and verification time divided by the total number or LRUs repaired.

6.2.30 Mean Time Between Critical Failures (MTBCF). MTBCF is the total FMC time divided by the total number of critical failures.

6.2.31 Mean Time Between Failures (MTBF). MTBF is the total FMC time divided by the total number of failures that require corrective maintenance.

6.2.32 Mean Time To Repair (MTTR). MTTR is the total time to perform all on-site corrective maintenance divided by the total number of corrective maintenance activities required. MTTR includes faulty LRU identification, LRU removal, LRU replacement, system test, and system return to FMC.

6.2.33 Minimum Usable Velocity. The minimum usable velocity is the weather radial mean velocity above which the bias errors contributed by the clutter suppression system are: 1) less than 2 dB for reflectivity, and 2) less than 2 m/sec for mean velocity and spectrum width, under the following conditions:

a. input signal to noise ratio of least 20 dB

b. input signal to clutter ratio of at least 30 dB

c. all velocity spectrum widths between 1 m/sec and 4 m/sec

6.2.34 Modular Construction/Module. Modular construction is the design technique which allocates single functions or groups of related functions to a single LRU. Modular construction is performed to minimize design complexity and maintenance activities.

6.2.35 Out-of-Trip Weather Echoes. Weather echoes due to distant storms which cause obscuration of first trip weather returns due to range aliasing.

6.2.36 Other RMMS Subsystems. The MDT, the Remote Monitoring Subsystem Concentrator (RMSC), and the Maintenance Processor Subsystem (MPS) are referred to herein as "other RMMS subsystems".

6.2.37 Preventive Maintenance. Preventive maintenance activities are those maintenance activities performed to ensure that the TDWR maintains its FMC and to prevent future inservice functional failure of equipment.

6.2.38 Product Baseline Configuration. The TDWR baseline configuration is the "as delivered" TDWR system configuration.

6.2.39 Radial Velocity. The radial component of the velocity vector. Mean radial velocities are averaged over time and space (a range-azimuth bin). Outbound radial velocities are defined as positive velocities and inbound radial velocities are defined as negative velocities.

6.2.40 Range Bin Filling Target. A weather target which extends across a range sample interval.

6.2.41 Range-Height Indicator Scans. The radar process in which the radar scans both range (distance) and height (angular elevation) at a constant azimuth angle.

6.2.42 Remote Monitoring Subsystem. A subsystem of the RMMS which is embedded in the TDWR to enable remote monitoring and control of all necessary and applicable functions of the TDWR.

6.2.43 Sector Scans. The radar process in which the antenna scans at constant elevation angle over an azimuth sector less than 360 degrees in azimuth.

6.2.44 Site Level Maintenance. Maintenance is performed at this level on systems, system segments, and support equipment in direct support of the TDWR System. It includes system maintenance monitoring, system fault isolation, and correction of system failures through the removal and replacement of LRUs, and preventive maintenance, but does not include repair, service, calibration, and verification of the removed LRUs.

6.2.45 Software Errors. Software reliability requirements are defined in terms of the number of unresolved errors as a function of their priorities. A software error is an occurrence during the execution of a program, attributable to software, of failure to perform as specified. Document errors which cause a performance failure shall be counted as software errors. Software errors are prioritized as follows:

a. Priority 1 - An error which prevents an operational function from performing as defined in applicable specifications (e.g. causes a program stop, an unusable product, or no product).

b. Priority 2 - An error which degrades the performance of an operational function as defined in applicable specifications and for which a reasonable alternative work-around solution exists. (Reloading or restarting the program is not an acceptable work-around solution.)

c. Priority 3 - All other errors, including those which cause operator inconvenience or annoyance but do not affect required operational functions, and intermittent errors. (An intermittent error is an error which can not be reproduced consistently when the same procedures and environment are duplicated.)

6.2.46 System. This term denotes the total electronic, electric power generating and distribution, and the structure to house, support, and protect the equipment.

6.2.47 Time Series Data. A series of digital in-phase and quadrature video samples as a function of time.

6.2.48 True Spectrum Width. The true spectrum width is defined to be the actual width (i.e., square root of the variance) of the radar scatterer velocity power distribution. This true width is distinguished from the measured width, which is just one realization of the true random process being observed.

6.2.49 Velocity Spectrum Width. The square root of the second spectral moment about the mean velocity.

6.2.50 Wind Shear. Any change in the wind speed and/or direction between two points in the atmosphere.

6.2.51 Wind shift. A boundary, straight or curved, representing a transition zone of a sustained change in the horizontal wind speed and/or direction, but primarily the wind direction. When moving, the usual case, it often results in the need to change active runways. The boundary usually separates air masses of different temperatures. Wind shifts are associated with thunderstorm gust fronts, cold fronts, warm fronts, and sea breeze fronts. The transition zone widths vary from 0.5 nmi (gust fronts and some cold fronts) to tens of miles (warm fronts and some cold fronts). All wind shifts are characterized by wind shear.

6.3 Notes.

6.3.1 Local Frost Depth Information. To obtain information concerning the local frost depth for particular sites, the contractor should contact either

a. The National Climatic Data Center, Asheville, N. C., or

b. U. S. Army Corps of Engineers, Cold Regions Research and Engineering Lab, 72 Lyme Road, Hanover, N. H. 03755.

APPENDIX A

PRODUCTS

10. **Purpose**. The outputs of the product algorithms require additional processing in order to provide a usable product to end-users. This appendix contains the top level system requirement for this processing. Engineering Report No. ER/300-87-08-001 contains the requirements for the formatting of the specific products.

10.1 **Product Generation and Transmission**. The TDWR shall generate and distribute each product within the time allocated in Table IV after collecting the data needed to generate the product.

10.1.1 **Product Priority**. The TDWR shall create and distribute products with the priority specified in Table IV.

10.1.2 **Product Distribution**. TDWR products shall be distributed to displays and ports in accordance with Table IV.

PRODUCT	FORMAT	PRODUCT DESTINATION INTERIM	PRODUCT DESTINATION NAS END-STATE	PRIORITY	TIME (sec)
Microburst	Graphical	SD	TCCC	1 (Highest)	15
	Alphanumeric	SD, RBDT	TCCC		15
	Alarm	SD, RBDT	TCCC		15
Gust Front	Graphical	SD	TCCC	2	15
	Alphanumeric	SD, RBDT	TCCC		15
	Alarm	SD, RBDT	TCCC		15
Precipitation	Graphical	SD	none	3 (lowest)	60

SD = Situation Display
RBDT = Ribbon Display
TCCC = Tower Control Computer Complex

TABLE IV - TDWR Products Destination

10.2 Microburst Product. The microburst detection product shall depict the current position and wind shear for microbursts and shall be implemented in accordance with Engineering Report ER/300-87-08-001 and in accordance with report DOT/FAA/PM-87-23.

10.2.1 Performance Design Goal. The TDWR shall be designed to provide microburst probability of detection within the required time of 0.99 or greater and a probability that any given alarm will be a false alarm of 0.01 or less. This requirement shall apply for all microbursts with a differential radial velocity of 10 m/s or greater which are located within 16 nmi of the radar and are within the scanned sector.

10.3 Gust Front Product. The gust front detection product shall depict the current position, two forecasted positions, post-frontal wind speed and direction, and wind shear for gust fronts and shall be implemented in accordance with Engineering Report ER/300-87-08-001 and in accordance with report DOT/FAA/PM-87-24.

10.4 Not Used.

10.5 Precipitation Product. A precipitation reflectivity product shall be implemented in accordance with Engineering Report ER/300-87-08-001 and shall have the following characteristics.

10.5.1 Levels. The product shall be quantized into site adaptable levels. The default levels shall be as follows:

a. Level 1 $\geq$ 18 & < 30 dBz

b. Level 2 $\geq$ 30 & < 41 dBz

c. Level 3 $\geq$ 41 & < 46 dBz

d. Level 4 $\geq$ 46 & < 50 dBz

e. Level 5 $\geq$ 50 & < 57 dBz

f. Level 6 $\geq$ 57 dBz

10.5.2 Computation of the Precipitation Product.

10.5.2.1 Base Data Used. For the 5 nmi range scale, the precipitation product shall be computed from the reflectivity base data obtained from a surface scan. At other range scales the product shall be computed using reflectivity base data obtained from a site adaptable elevation angle available in the operational scan strategy.

10.5.2.2 Update Rates. The update rate shall be 1 minute when the 5 nmi scale is displayed on the situation display and 5 minutes for all other range scales.

10.5.2.3 Product Format. The precipitation product shall be computed as an array of square cells, each representing an area of: (1) 0.25 kilometer x 0.25 kilometer square on the Earth's surface when the 5 nmi scale is displayed on the situation display, and (2) 1 kilometer square on the Earth's surface when the 15, 30, or 50 nmi scale is displayed on the situation display.

10.5.2.4 Definition of Cell Value. The product value assigned to an output cell shall be computed as an average of the reflectivity values in each range-azimuth cell of base data which overlap the output cell. The averaging of reflectivity values shall be performed by averaging Z values, i.e., converting the reflectivity measurements from logarithmic units (dBz) to linear units (Z), then averaging in linear units and converting back to logarithmic units.

10.5.3 Attenuation. The precipitation product shall detect attenuation due to precipitation and shall flag those areas where attenuation has probably caused a dBz shift above a site adaptable threshold. The threshold shall be set via the RMS.

APPENDIX B

DISPLAY REQUIREMENTS

20.1 Introduction. This appendix describes displays that shall be provided with the TDWR. The requirements of this section apply in addition to all requirements in Section 3.

20.1.1 Situation Display Requirements .

20.1.1.1 General Requirements.

20.1.1.1.1 Size. The viewing screen of the situation display shall be 13 inches to 16 inches measured diagonally. The footprint of the situation display shall not exceed 2 1/2 square feet. For the purpose of this requirement the viewing screen, if separate, may be placed above any processing unit.

20.1.1.1.2 Start-up Characteristics. The situation display shall require no more than one action for power turn on and full operation. The system shall query the user as to the active runway configuration. No other input or actions shall be required to initiate full operation.

20.1.1.1.3 Memory. The situation display shall retain display adaptation parameters and settings during power outages and shutdown.

20.1.1.1.4 Environment. The situation display shall be in accordance with FAA-G-2100 for Environment I.

20.1.1.1.5 Readability. The situation display shall be readable in full sunlight. The use of an adjustable hood is permitted. The situation display shall have an adjustable brightness control. The displayed characters, graphics, and symbols shall be readable from a distance of 5 feet and ± 40 degrees without adjustment of any hood.

20.1.1.1.6 Lifetime. The situation display shall have a lifetime of 7 years or greater.

20.1.1.1.7 Color. The situation display shall display a minimum of 8 colors. Colors shall be selectable from a palette of 64 colors, minimum.

20.1.1.1.8 Protection of Display Adaptation Parameters. The situation display shall be protected against inadvertent or unauthorized modification of display adaptation parameters. These shall include but not be limited to:

a. Display center point

b. Background Maps and Airport Map

20.1.1.2 Message Types.

20.1.1.2.1 Alphanumeric. The situation display shall display alphanumeric characters and messages.

20.1.1.2.2 Graphic. The situation display shall display vector and bit (image) graphics. The resolution of bit graphics display shall be 640 by 480 pixels, minimum.

20.1.1.3 Input Device.

20.1.1.3.1 Track Ball. A track ball with at least one push button switch shall provide operator command input. This device shall be in accordance with MIL-STD-1472. A keyboard shall not be required except for maintenance actions.

20.1.1.4 Alarms.

20.1.1.4.1 Visual. The Situation Display shall provide a visual alarm to annunciate new hazards or significant weather events, as described in Engineering Report ER/300-87-08-001.

20.1.1.4.2 Audible. The Situation Display shall provide an audible alarm. The audible alarm volume shall be adjustable between 60 dBA and 85 dBA. Adjustment shall not require tools. The audible alarm shall be protected from accidental adjustment. Alarms shall be generated as described in Engineering Report ER/300-87-08-001.

20.1.1.4.3 Disable. The Situation Display shall provide a means to disable audible alarms. Positive indication of the audible alarm enabled/disabled status shall be provided. The Situation Display shall incorporate a means to reset audible alarms.

20.1.1.5 Commands.

20.1.1.5.1 Command Acceptance. The Situation Display shall execute the following operator commands:

a. Select one of four precipitation level display choices (Described in Engineering Report ER/300-87-08-001).

b. Select one of four range scales to be displayed (Described in Engineering Report ER/300-87-08 001).

c. Select one of three gust front mov ment display choices (Described in Engineering Report ER/300-87-08-001).

d. Select background maps to be displayed. (Described in Engineering Report ER/300-87-08-001).

e. Select display colors. (See Engineering Report ER/300-87-08-001).

f. Archive most recent hour of data.

g. Set the active runway(s).

20.1.1.5.2 Operation. The operator command input shall operate in a menu driven fashion. Operator inputs shall be displayed prior to execution.

20.1.1.5.3 Site Adaptable Parameter. Situation Displays shall accept the following site adaptable parameter:

a. Move display center to selected point.

20.1.1.5.4 Update. The graphic and alphanumeric products shall be updated within 15 seconds of a set active runway operator command input.

20.1.1.6 Display Formats.

20.1.1.6.1 Format. The situation display shall reserve screen space for:

a. Ribbon display alphanumeric messages

b. TDWR status message

The ribbon display alphanumeric message screen space shall be expandable in size to permit viewing of undisplayed messages.

20.1.1.6.2 Color. The situation display shall display products using operator selectable colors for (See Engineering Report ER/300-87-08-001):

a. each alphanumeric product

b. each graphic product

c. status

d. background for each screen field

e. maps

f. ARENAs

g. active runway configuration

h. each level of all products containing multiple levels, e.g., the precipitation product.

20.1.1.7 Power. Power shall be single phase, 60 hertz, 120 VAC. Power consumption shall be less than 500 watts.

20.1.1.8 Maps. The Situation Display shall accept, generate, modify, and display background maps and an airport map with up to 1000 segments and 100 characters that are provided.

20.1.1.9 Not Used.

20.1.2 Ribbon Display Requirements.

20.1.2.1 General Requirements.

20.1.2.1.1 Size. The Ribbon Display shall have the least area required to display 10 lines of 25 characters, in accordance with the requirements of this specification and MIL-STD-1472.

20.1.2.1.2 Start-up Characteristics. The Ribbon Display shall require no more than one action for power turn on and full operation.

20.1.2.1.3 Environmental. The Ribbon Display shall be in accordance with Environment I, FAA-G-2100.

20.1.2.1.4 Readability. The Ribbon display shall be readable in full sunlight. The Ribbon Display shall have an adjustable brightness control. The Ribbon Display shall be readable from a distance of 10 feet and at angles of ± 60 degrees from center line. No hood shall be used.

20.1.2.1.5 Lifetime. The Ribbon Display shall have a lifetime of 7 years or greater.

20.1.2.2 Message Type. The messages shall be alphanumeric.

20.1.2.3 Input Device. The Ribbon Display shall incorporate a switch to disable audible alarms. The switch shall provide a positive indication of the audible alarm enabled/disabled status. The switch shall incorporate a protective mechanism to prevent accidental changes of status. The Ribbon Display shall incorporate a push button switch to reset alarms. The switch shall incorporate a protective mechanism to prevent unintentional clearing of alarms.

20.1.2.4 Alarms.

20.1.2.4.1 Visual. The Ribbon Display shall provide a visual alarm to alert users to the presence of a hazard, as described in Engineering Report ER/300-87-08-001.

20.1.2.4.2 Audible. The Ribbon Display shall provide an audible alarm to alert users to the presence of a new hazard. The audible alarm shall have a distinctive, non-irritating sound. The audible alarm volume shall be adjustable between 60 dBA and 85 dBA. Adjustment shall not require tools. The volume control shall be protected from accidental adjustment. Alarms shall be generated as described in Engineering Report ER/300-87-08-001.

20.1.2.5 Power. Power shall be single phase, 60 hertz, 120 VAC. Power consumption shall be less than 200 watts.

APPENDIX C

RADAR FREQUENCIES

Number	Frequency (MHz)
1	5600
2	5601
3	5602
4	5603
5	5604
6	5605
7	5606
8	5607
9	5608
10	5609
11	5610
12	5611
13	5612
14	5613
15	5614
16	5615
17	5616
18	5617
19	5618
20	5619
21	5620
22	5621
23	5622
24	5623
25	5624
26	5625
27	5626
28	5627
29	5628
30	5629
31	5630
32	5631
33	5632
34	5633
35	5634
36	5635
37	5636
38	5637
39	5638
40	5639
41	5640

Number	Frequency
42	5641
43	5642
44	5643
45	5644
46	5645
47	5646
48	5647
49	5648
50	5649
51	5650